Barcelona, a city committed to the environment

2018

Introduction

This report addresses the state of the environment in Barcelona through eleven thematic chapters.

Each chapter defines the future vision of the city in terms of each specific theme, providing a background picture and the current situation with a series of indicators. The measures implemented over the past five years and which have contributed to the current position are also outlined, as are those already planned or which are expected to be applied in the near future, enabling us to move towards our vision for the future.

The aim of this report is not to provide an exhaustive compilation of all the activities carried out but to highlight the most significant ones over the past five years, either because this allows us to understand the current situation and how we intend to achieve the objectives set, because they have led to progress in environmental matters, because they are innovative or because they have had a big impact and led to good practices. These include original, unique and flagship measures that can also serve as an inspiration to other cities. Maintaining the format of the previous report, the measures are presented in different ways, depending on the type of measure in question.

The information corresponds primarily to the activities of Barcelona City Council, although, given many aspects of the environment are outside the City Council's powers, actions involving other public authorities such as the Barcelona Metropolitan Area, the Barcelona Provincial Council or the Government of Catalonia have also been included.

Types of measures

- Planning and management
- Tools and actions in general
- Cooperation, international work and the exchange of experiences
- Improving knowledge, information, participation and empowerment

2017 Barometer

Territory

02º 07’ 31’’ E longitude

41º 25’ 10’’ N latitude

9 m high

102,158,777 m² of surface area

158.7 inhab./ha density

28.35 km² of green space

4,780 m of beaches

Climate

16.4 ºC annual average

33.8 ºC maximum

-0.8 ºC minimum

2,607.9 hours of sun per year

969.6 hPa on average

985.6 hPa maximum

941.3 hPa minimum

73% relative humidity

518 mm total

100.2 mm/day maximum precipitation

123 days of rain

17 days of storms

Population

1,620,809 inhabitants

4,793,592 inhabitants in the metropolitan area (2016)

22,5% foreign population

84.3 anys life expectancy (2016)

8.5 birth rate (2016)

9.4 death rate (2016)

9,065,650 tourists

19,162,580 overnight stays

Social indicators

19,335 €/year
disposable household income per capita

19.2%
at risk of poverty

91.2%
finish secondary education (2015-2016)

85.4%
homes with Internet access

Economic indicators

47,600
GDP per capita Base 2010

11.6%
unemployment rate

80.2%
activity rate (4th quarter)

74.4%
employment rate

Environmental indicators

17.45 m²/inhab.
of green space

✗ *2013 – 18,1 m²/inhab.*

15,614 GWh
total power consumption (2016)

✓ *2013 - 16.609 GWh*

108.3 l/inhab./day
domestic water consumption

✓ *2013 – 108,4 l/inhab./day*

799,981 tonnes
of solid urban waste (2018)

✗ *2013 – 730.285 tonnes*

36%
selective waste collection

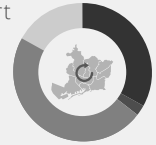
✗ *2013 – 36,2%*

8.2 million
journeys per day

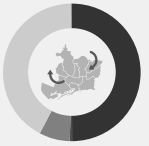
74,4% ecomobility (public transport + bicycle + on foot)

64,2% internal journeys **35,8%** connecting journeys

- Public transport
- Bicycle
- On foot
- Private vehicle



83,1%
ecomobility



59%
ecomobility

42 micrograms/m³
of NO_2 on average per year

✗ *2013 – 40 micrograms/m³*

25 micrograms/m³
of particles (PM_{10}) on average per year

✗ *2013 – 24 micrograms/m³*

Contents

Energy and climate change mitigation

Barcelona tackles climate change

Energy and climate change mitigation

Vision of the future

Becoming a carbon neutral city

Current situation

Final energy consumption (2016)

15,614 **GWh**

9.71 **MWh** per capita

Self-sufficiency

2012 **2.08 %**

2016 **2.65 %**

CO_2-e emissions

2012 **2.28** **tCO_2-e** per capita

2016 **2.18** **tCO_2-e** per capita

Lines of action

Commitment to becoming a carbon neutral city "Adhesion to the Covenant of Mayors for Climate & Energy" "Climate Plan" "Barcelona Climate Commitment"

Energy saving and efficiency "Home renovations" "Renewal of lighting" "Electric vehicles"

Generation of renewable, local energy "Public electricity distributor" "Solar generation for municipal buildings and public spaces"

Energy culture "Citizen climate projects" "Map of energy resources" "Energy advice points" "Energy saving marathon"

1.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to become a carbon neutral city by 2050 and, as part of this transition, it has set the goal of reducing greenhouse gas (GHG) emissions per capita between 2005 and 2030 by 45%. To this end, the city is promoting its own energy model based on savings, efficiency and harnessing renewable, local resources to progress towards self-sufficiency and energy sovereignty, reducing its external energy dependency and improving the environmental quality of the urban area. Furthermore, it places residents at the centre of energy and climate change policies and provides them with more decision-making capacity and power, particularly in terms of self-sufficiency.

In the transition towards a sustainable energy model that makes it possible to mitigate climate change, Barcelona has harnessed the opportunities provided by certain aspects inherent to the city, such as its mild climate, but it still faces outstanding and emerging challenges.

- **Barcelona, a compact, dense and Mediterranean city.** On the one hand, these characteristics facilitate low ratios of energy consumption per inhabitant compared to other cities. On the other, given the lack of large spaces, the use of roofs and terraces is key in generating renewable, local energy.
- **The low renewability of Barcelona's energy mix.** Almost all the primary energy consumed in the city is from fossil or nuclear fuels, and renewable energy accounts for just 7.83% of all energy. This energy model therefore has obvious limits: economic (high energy prices, existing limitation on resources), social (inequality and energy poverty) and environmental (air pollution and GHG emissions that cause climate change) limits.
- **Emissions remain high.** Total energy consumption and GHG emissions in Barcelona have decreased in recent years, in large part due to the economic crisis and the increase in energy prices. However, as the 2015 and 2016 data shows, energy consumption and the generation of emissions have increased again as a result of the economic recovery and, in particular, on account of the upturn in mobility, a trend that is expected to increase in the coming years. There is therefore a need to spread a new energy culture that uncouples economic growth from energy consumption.
- **Climate justice: more vulnerable individuals and more energy poverty.** Climate change and its effects can lead to an increase in the price of basic supplies and change energy and water consumption patterns, which may enhance vulnerability in terms of energy poverty. In addition, given the demographic and socio-economic dynamics in the city, the vulnerable population is expected to increase because there will be more households with dependent children and more single-person households, while migratory movements will grow and the ageing process will be more evident.
- **Municipal action in terms of energy is limited.** Given the framework of local government powers, municipal action is focussed mainly on aspects related with local energy management (promoting energy saving, energy efficiency and demand management in the municipal sphere and across the city), on generating renewable energy at local level, prioritising self-generation and self-sufficiency, and working on ensuring basic supplies while spreading the energy culture among the general public.

1.2 General context and current situation

For many years Barcelona has worked to combat and respond to the effects of climate change. Efforts have therefore been made to adopt international and local commitments such as approving strategic measures and plans that seek to mitigate the effects of climate change.

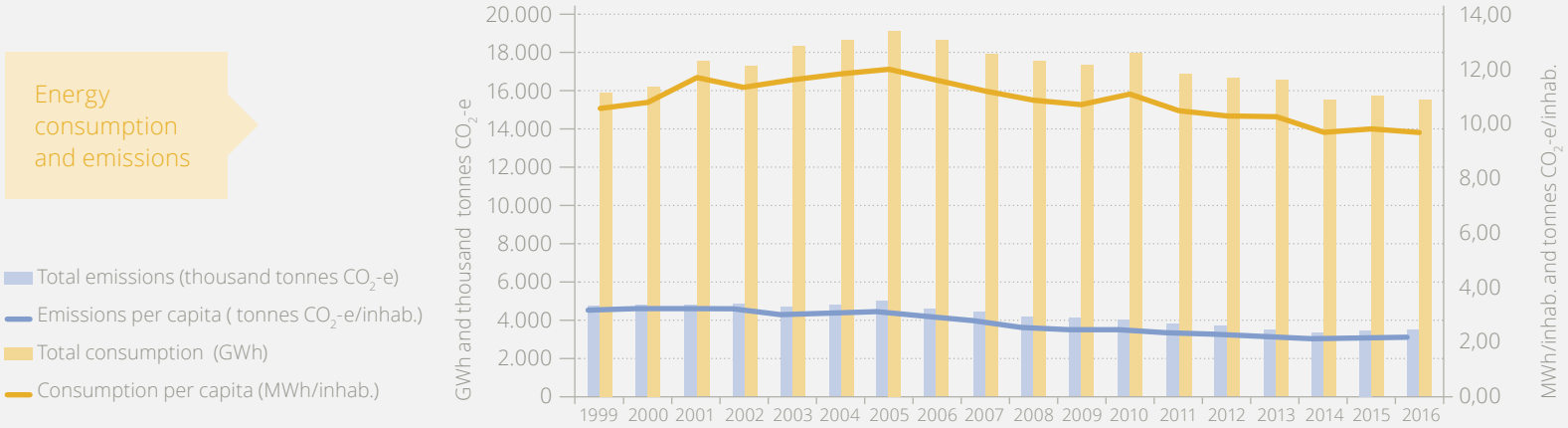
With the Barcelona Energy, Climate Change and Air Quality Plan (2011-2020) ⊕, the city established a roadmap to reduce GHG emissions by 23% per capita between 2008 and 2020. The Climate Plan goes even further and seeks to reduce emissions by 45% per capita by 2030. However, to achieve this objective we need to reduce energy consumption further still and minimise fossil fuel dependency, as only 7.83% of the primary energy consumed in the city is from renewable sources. Thus, the energy transition towards clean, renewable and local energy sources is essential.

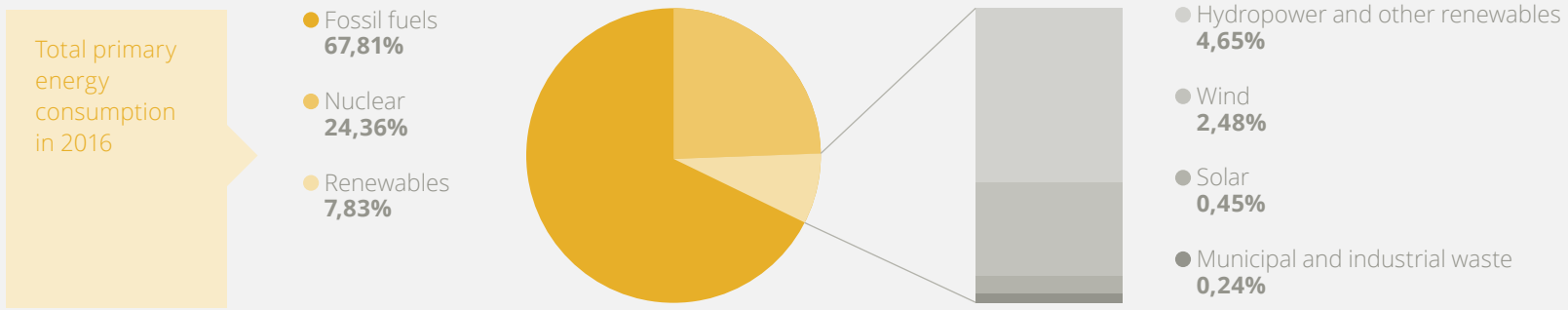
1.2.1 Reduction in energy consumption, despite current stabilisation

Final energy consumption in Barcelona has decreased by 19% in recent years, from 19,263 GWh in 2005 to 15,614 GWh in 2016, returning to the 1999 value of 15,943 GWh. However, it is worth pointing out the increase between 1999 and 2005, when consumption levels peaked. The economic crisis and the rise in energy prices have contributed in a large measure to the implementation of energy-saving actions and good practices previously not considered. This shows there is a clear correlation between energy consumption and the socio-economic context.

The evolution of energy intensity in Barcelona demonstrates that the city has been capable of consuming less energy per euro generated, from 261.56 Wh/€ in 1999, to

Energy consumption and emissions





205.19 Wh/€ in 2016. Furthermore, there have been signs that energy consumption and economic growth are not as closely associated as they used to be.

Likewise, it is expected to increase in the coming years on account of the economic recovery. In fact, energy consumption increased again in 2015 and 2016, reaching 15,842 GWh and 15,614 GWh, respectively. There is therefore a need to spread a new energy culture that uncouples economic growth from energy consumption.

The sectors that consumed most energy in the city (2016) were commerce and services (34.02%), followed closely by the transport (27.30%) and domestic (27.17%) sectors, then industry (10.85%) and other sectors (0.65%).

Fossil fuels accounted for 67.81% of the total primary energy consumption in 2016, nuclear for a further 24.36% and renewables for just 7.83%. As regards the form, 41.23% of the energy consumed in Barcelona was electricity, 30.62% natural gas, 27.29% automotive fuel and 0.86% liquefied petroleum gas (LGP). With regard to the source of electricity, 56.29% of what we consume comes from nuclear power, 25.62% from fossil fuels and the remaining 18.09% from renewable sources.

A total of 27,624 GWh of primary energy were required to provide the 15,614 GWh of final energy that Barcelona consumed in 2016. That means only 57% of the primary energy was transformed into useful final energy. Or, to put it another way, 43% of the primary energy was lost in generation and transport. Therefore, we also need to increase the efficiency of these processes with more suitable technologies, an aspect that directly depends on the big power stations.

1.2.2 Continued growth in the generation of local renewable and residual energy

In 2016, 413.37 GWh were generated using renewable sources and harnessing local residual energy. This amount of energy accounted for 2.65% of all energy consumed in the city that year (15,614 GWh). However, this is not enough: the energy self-sufficient index has grown significantly since 2003 and each year it grows even more.

The main source of renewable and residual energy is the recovery of solid urban waste at the Sant Adrià de Besòs plant (53.0%) and thermal solar power (20.1%).

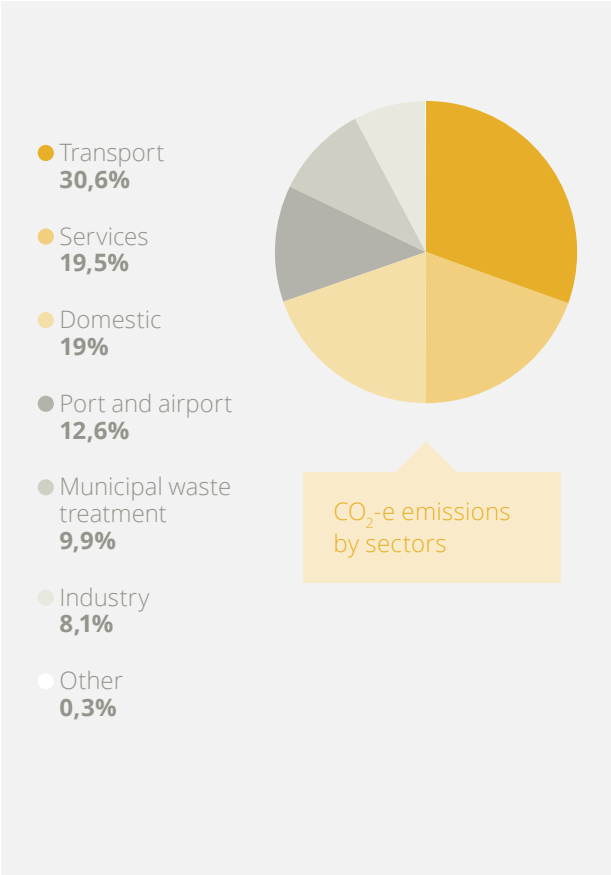
Currently, Barcelona has photovoltaic generation systems in public buildings and on pergolas and dividing walls, which means an installed power of 2,078 kWp that generates almost 2,570 MWh/year, equivalent to the consumption of 1,116 households and a saving of 825 tonnes of CO_2-e emissions.

1.2.3 Reduction of emissions throughout all sectors

In 2016, Barcelona emitted a total of 3,512,512 tonnes of CO_2-e, which comes to 2.18 tonnes of CO_2-e per capita, well below the emissions recorded in 1999, which came to 3.20 tonnes of CO_2-e. From then on, there was an upward trend until 2005, when it reached 3.14 tonnes of CO_2-e, after which we saw the start of a downward trend.

These emissions are mainly generated by the transport sector (30%), followed by the commerce and services sector (19%) and the domestic sector (19%). The remainder is split between the port and airport (13%), municipal waste treatment (10%), industry (8%) and others.

However, since 1999, emissions in the various sectors have not followed the same trend. While they have increased in the commercial and service sectors (above all due to the increase in the share of tourism consumption and commercial activity linked to that), they have remained very stable in the domestic and transport sectors, while falling in industry.



1.2.4. More climate change, more energy poverty, more climate justice

Currently, 10.6% of Barcelona's population suffers from energy poverty, which translates to around 69,500 homes. That means 9.4% of the population cannot maintain their household at an adequate temperature during the cold months, while 14.5% say they are behind with utility payments and 9.2% say the have leaks and damp in their home.

Furthermore, it is expected that climate change will see an increase in the cost of water, energy and foodstuffs, which will make access to these basic resources even more difficult. Given the demographic and socio-economic dynamics in the city, the vulnerable population is also expected to increase because there will be more households with dependent children and more single-person households, while migratory movements will grow and the ageing process will be more evident.

As a result, these factors may lead to an increase in energy poverty and make the situation worse. Climate justice must therefore be encouraged and the most vulnerable placed at the centre of climate policies in order to ensure everybody can keep their homes at a healthy temperature (18-20ºC in winter and 25ºC in summer) and has access to minimum amounts of drinking water (100 litres per person per day).

1.3 Measures adopted to move towards the energy transition and mitigate climate change

Barcelona, on the way to becoming a carbon neutral city, has implemented energy saving and efficiency measures, promoted renewable, local energy generation and encouraged public participation.

1.3.1 Commitment and planning in the transition towards carbon neutral cities

Adhesion to the Covenant of Mayors for Climate & Energy

On 31 March 2017, Barcelona adhered to the new covenant that merged previous European climate change mitigation and adaptation initiatives, known as the Covenant of Mayors, signed in 2008, and the Mayors Adapt, signed in 2014.

Following its adhesion, Barcelona City Council has been committed to reducing greenhouse gas emissions per capita 40% by 2030, compared to 2005, and draw up a sustainable energy and climate action plan (SECAP). However, on account of the Catalan Climate Change Act, Barcelona has gone even further and committed to reducing its emissions by 45%.

Beyond the European Union, the two main global initiatives at a city and local government level have been combined to make progress with the transition towards a low-carbon and climate-resilient economy, and demonstrate the global impact of local action: the Compact of Mayors, signed in 2015 and the Covenant of Mayors. Barcelona signed up to the Global Covenant of Mayors for Climate and Energy in 2016, and has recently obtained the stamp of absolute approval in terms of all objectives.

Barcelona Climate Commitment

Coinciding with the Paris United Nations Climate Change Conference, at the end of 2015 Barcelona presented its collective action commitment ⊕, supported by more than one thousand companies, citizen organisations and schools associated with the More Sustainable Barcelona network and the City Council itself, to help reduce emissions and adapt to climate change with the following targets for 2030:

As a result, Barcelona joins cities like London, Paris and New York, which have promoted a wide range of climate change actions.

- With regard to mitigation, to reduce levels of CO_2-e by 40% per capita compared to the levels of 2005.
- With regard to adaptation, to increase the urban green space by 1.6 km^2, in other words, 1 m^2 per resident.

Transition to energy sovereignty

In 2016, Barcelona presented the government measure "Transition towards Energy Sovereignty" ⊕, as part of which it set out its commitment to making progress towards all energy being renewable, with zero emissions and democratically accessible to everybody.

This energy transition is based on implementing energy saving and efficiency measures, such as building renovation; measures to increase local, renewable energy generation, such as taking advantage of roofs and roof terraces; and measures to ensure energy supplies, such as setting up a public electricity distributor. Actions have also been established to promote the energy culture amongst the players involved and educate the public to get them involved in the change.

1.3.2 Tools for facilitating the rational use of energy in buildings, homes and public space

Housing renovation grant programme

As part of the 2016-2019 Urban Renovation Strategy, the 2017 call for housing renovation grant applications promoted actions aimed at power generation and energy saving, subsidising up to 60% of the cost of installing photovoltaic or thermal solar panels and 50% of the cost of actions to improve energy overall. Along the same lines, the 2018 call promoted actions aimed at increasing energy efficiency and energy production, with grants of up to 50%.

The measures implemented in 2017 generated savings of 1.8 GWh/year, equivalent to the annual consumption of 780 families, while 280 MWh/year were generated, equivalent to the annual consumption of 120 families.

Plan for Energy Saving and Improvements in Municipal Buildings (PEMEEM)

Energy consumption associated with municipal buildings and facilities accounts for 56% of the consumption associated with municipal activities (282 GWh/year). So taking action there is key. Actions to reduce energy consumption, increase energy efficiency and include renewable energy in municipal buildings are included in this plan.

The PEMEEM also monitors public space development projects to ensure they take advantage of local renewable and residual energy sources.

2018 -2020 Comprehensive Lighting Renovation Plan

In recent years, efforts have been made to improve lighting levels, energy efficiency and functional intelligence. Electricity consumption by the public lighting system has decreased by focussing on 10% of the system, which translates to around 13,000 light points and promoting autonomous lighting, which generates its own electricity. Traffic lights have also been replaced and the network has been renovated by installing LED technology. Under this new plan, work is planned on 200 streets and 10,000 new LED lights are due to be installed, which represents energy saving of approximately 3,620 MWh/year, equivalent to the electricity consumption of 1,550 families.

Vehicle energy diversification

Barcelona City Council is committed to vehicle energy diversification and, more specifically, the use of electric vehicles in the city. To that end, Barcelona has 450 free public charging stations, of which 125 are specifically for motorbikes and 17 are fast charging stations. Likewise, free parking is also available in green and blue zones for electric vehicle users in addition to a 75% rebate on motor vehicle tax.

This commitment is reflected internally in the council's own fleet: 24% are electric vehicles (703), 20% are gas powered (584) and 7% are hybrid (208). That means 51%

of the total fleet is made up of low-emission vehicles. As regards the city's buses, 35% run on natural gas, 19% are hybrid and 4 are electric (2018 data).

Technical instructions for the application of sustainability criteria

As part of the "More Sustainable City Council" programme, in 2015 the Council drew up 12 sets of technical instructions ⊕ that must be followed in the acquisition and procurement of groups of goods and services defined as priorities, in response to and in compliance with the Government Measure on Responsible Public Procurement with Social and Environmental Criteria (2013). The following environmental criteria have also been established with regard to energy:

- → 100% of electricity supplied must be certified as green electricity with a guarantee of origin.
- → For organising events, criteria have been established to promote sustainable mobility and energy efficiency.
- → For public works projects, both in public spaces and construction, maximum energy self-sufficiency criteria have been established. In the case of buildings, criteria have been established in accordance with an energy protocol so that all new municipal buildings and large-scale renovations must be designed to consume low amounts of energy (minimum demand) and maximise generation. In the case of public spaces, both new developments and redevelopments, minimum demand is required for power consuming elements (minimum consumption) and power generating elements, such as solar panel pergolas, must be included as far as possible provided that resources are available.
- → As regards vehicles, procuring electric vehicles has been made a priority.

First Barcelona energy saving marathon

In February 2018, a total of 47 public buildings and infrastructures in Barcelona took part in the first energy saving marathon ⊕ to make people more aware of the need to reduce energy consumption under the "More Sustainable City Council" programme and the Plan for Energy Saving and Improvements in Municipal Buildings.

Thanks to the actions carried out over the course of the month, such as using half the volume of toilet tanks, taking stairs instead of using lifts or setting a heating system temperature in advance, participating infrastructures and buildings managed to reduce gas expenditure by 20.21%, water expenditure by 14.77% and electricity expenditure by 5.74%. This is equivalent to the monthly energy consumption of 1,083 four-person families and almost two Olympic swimming pools.

1.3.3 Promoting the generation of local, green energy

Creating a public electricity distributor

Barcelona Energia ⊕ has supplied 100% renewable energy from nearby sources (with a certificate of origin) to the City Council's buildings, infrastructures and facilities and those of its dependent bodies, in addition to the city's public lighting system, since July 2018. From 2019, facilities in the Barcelona Metropolitan Area and the residents of the city and the Metropolitan Area as a whole are also due to be offered this service, covering up to a maximum of 20,000 homes.

Programme to promote solar power generation in Barcelona

In order to achieve the objective of doubling solar power generation in municipal buildings and increase private generation by 10%, as established in the "Transition towards Energy Sovereignty" measure, the Programme to Promote Solar Power Generation in Barcelona sets out activities to be performed between 2017 and 2019. They focus on putting solar panels on public and private roofs and terraces across the city and in public spaces, on converting or installing urban features that can be converted into power generators, through public and private investment.

There are currently around 60 municipal buildings with photovoltaic generation systems and 16 pergola generators have been installed in parks and squares. Solar power systems have also been installed in sports facilities such as Can Ricart and Can Caralleu. In addition, 10 more infrastructures are being installed on existing buildings and a further 17 are about to be tendered.

The Map of photovoltaic energy generation ⊕ in municipal buildings and spaces makes it possible to consult municipal buildings, pergolas and dividing walls that generate solar power, in addition to the energy they produce, the number of homes they are capable of powering, CO_2-e savings, etc.

The pergola in Plaça del Centre, in Les Corts, supplies 70% of the energy needs of the square's lights.

1.3.4 Extending the energy culture to involve citizens in the change

City residents climate projects

As a result of the Barcelona Climate Commitment, teams comprising different organisations participating in More Sustainable Barcelona were created, with a view to implementing citizen projects that promote the reduction of GHG emissions, the city's adaptation to climate change and climate justice. The new projects associated with the Commitment are:

- E4: Plug into energy saving and efficiency
- Passive reform and active awareness for combating energy poverty
- Mosaic roofs. Making our roof terraces sustainable
- Safe school paths
- Cycling to work
- Green Point 2.0
- Sarrià zero waste
- Let's Stand Together Against Climate Change
- #CompromísPelClima campaign

To continue stimulating citizen action, a call for subsidies for citizen projects that fight climate change was launched in 2018. These subsidies seek to support projects that promote mitigating and adapting to climate change and provide them with funds through energy efficiency and saving actions, increasing the use of renewable energy, sustainable mobility, agricultural and green spaces, waste prevention, etc. and that contribute to achieving the Commitment goals.

A total of 49 projects were submitted to this first call, with the 11 most noteworthy receiving total subsidy of €200,000.

Energy resource map

Many of Barcelona's buildings have suitable conditions for installing power generation equipment on their roof terraces. To raise awareness of all this potential, the City Council has created the Barcelona energy resource

map, where it is possible to consult energy potential based on the resource in question (photovoltaic solar, thermal solar or mini wind) and information is provided on the potential power that can be generated, savings in terms of greenhouse gas emissions and the estimated installation cost. Thus, people can consult the energy resource that would be best suited to their roof. The Practical Self-Consumption Installations Guide has also been published.

Creation of energy advice points

Barcelona has ten energy advice points (PAEs) spread across the city. These points offer the information, assistance and advice needed for people to exercise their energy rights. In addition, advice is offered to the general public on processing social bonds, grants for improving energy efficiency in the home and cutting utility bills.

In 2017, the energy advice points received over 6,000 visits.

Tools and resources for increasing the energy culture

As part of the "Carrega't d'energia" programme, the Council has set up a virtual tool to calculate how much energy is consumed in the home and how to reduce consumption and improve energy efficiency in the home: the energy calculator. The Fàbrica del Sol environmental education centre also holds workshops to educate the public on the energy transition, such as "Breaking down gas and electricity bills", "Measures for improving energy in the home" and "Renewable energy in the home".

1.4 Future goals and measures

In response to the commitment the city made by adhering to the Covenant of Mayors for Climate & Energy in 2017, Barcelona has drawn up a Climate Plan ⊕, a new roadmap to tackle climate change up to 2030.

2018-2030 Barcelona Climate Plan

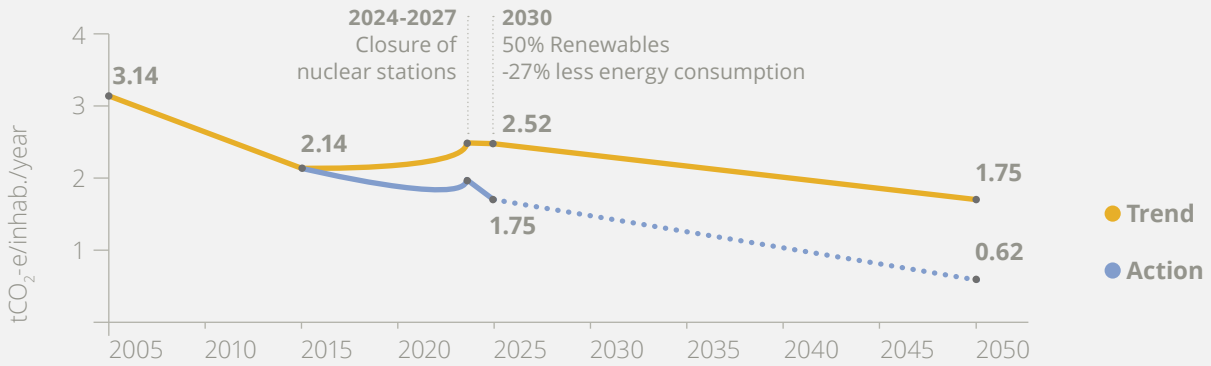
To analyse the future evolution of energy consumption and emissions in Barcelona to 2030, two scenarios have been defined: the trend scenario, which takes into account the expected performance of different contextual factors (population, GDP, mobility, distribution and update of the mobile park, etc.) and the electric mix proposed by the Catalan Climate Change Act; and the action scenario, which also takes into account the application of Climate Plan measures.

In the trend scenario, energy consumption is expected to increase by 0.14% per year. However, given the expected increase in population, it is expected that consumption per inhabitant will reduce from 9.71 to 9.52 MWh/inhab. In contrast, by applying the Climate Plan measures it is hoped that consumption per inhabitant will be reduced by 29.48%, which is equivalent to an annual fall in energy consumption of 2.46%.

In terms of emissions, the trend scenario takes into account the decommissioning of nuclear power plants and a significant increase in renewable energy, as established by the Catalan Climate Change Act. This would result in the emission factor associated with electricity generation increasing and GHG emissions growing by 17.70% to 2.52 tonnes CO_2-e/inhab. In 2030. In contrast, by applying the Climate Plan actions, it is expected that per capita emissions will be reduced by 18.22% compared to the figures recorded for 2016 (and 45% compared to 2005).

By applying the measures set out in the Climate Plan, it will be possible to break the present consumption and emis-

In the action scenario, we achieve the reduction targets 20 years earlier than in the trend scenario



sion dynamic and reach 2050 with neutral levels. If the Climate Plan is not implemented, in 2050 the trend scenario would put us in the situation we foresee being in by rolling it out in 2030. In other words, we advance 20 years. Also, not implementing the Plan would mean the efforts required would be greater, more costly and less fair.

The Climate Plan establishes strategic goals and measures in the short-term (2018-2020) and in the medium to long term (2021-2030) structured around four strategic pillars: mitigation, adaptation and resilience, climate justice and promoting citizen actions. To achieve these, the Plan features eighteen lines of action divided into five different areas:

→ **People first:** the well-being of residents.

→ **Starting at home:** improving efficiency in buildings.

→ **Transforming communal spaces:** transforming public spaces into healthy, biodiverse, efficient and inclusive settings.

→ **Climate economy:** uncoupling the quality of people's lives from economic growth, with a circular vision that makes the most of resources and avoids generating waste and emissions.

→ **Building together:** in collaboration with an informed, critical, proactive and empowered citizenry.

In terms of energy and mitigation, joint action seeks to make Barcelona a completely carbon neutral city by 2050 and reduce GHG emissions per capita by 45% compared to 2005 by:

→ Reducing travel by private motor vehicles by 20%.

→ Increasing solar power generation fivefold.

→ Carrying out energy renovation in 20% of residential buildings that are more than 40 years old and renovating 94,000 homes, prioritising those belonging to vulnerable families and those at risk of social exclusion.

→ Reducing the 7% of GHG emissions associated with the energy consumption of municipal buildings and facilities.

→ Procuring 100% low-carbon public transport buses, taxis and municipal fleets by 2025.

→ Having 95% of the population at less than 300 m from a bike lane by 2018.

→ Saving 130,000 tonnes of CO_2-e in the collection and treatment of waste.

The Plan also sets the target of zero energy poverty and achieving 100% of net financing.

To achieve these goals, the Plan defines energy saving, efficiency and self-generation measures in buildings, facilities and developed spaces; low-emission transport and mobility services; urban activities with a reduced impact on the city's metabolism and its urban services; and awareness raising, empowerment and occupancy measures.

Resilience and adapting to climate change

Barcelona adapts to the risks and impacts of climate change

Resilience and adapting to climate change

Vision of the future

Becoming a resilient city capable of overcoming current and future challenges

Current situation

Climate change
Main impacts

Committed scenario

+ 1.6 ºC by 2050
+ 1.7 ºC by 2100

- 14 % rainfall

Sea level **+ 46-115** cm by 2100

Passive scenario

+ 2 ºC by 2050
+ 3 ºC by 2100

- 26 % rainfall

Sea level **+ 64-133** cm by 2100

Main challenges

Heat waves · Droughts · Floods · Shrinking beaches

Worse air quality · Heat island effect · Change in energy consumption patterns · Loss of biodiversity · Fires

Lines of action

Planning "Climate Plan" "Urban resilience strategy"

Minimising the impacts of climate change
"Protocol for heat waves" "Guaranteed supply of resources" "Flood management" "Conservation of vulnerable species"

Adaptation
"Climate refuges"

2.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to become a resilient city, capable of facing current and future challenges and reducing its vulnerability in all aspects affecting its citizens' lives. It wants to be a proactive city that anticipates risks to ensure the city's functionality and improve its response capacity.

To achieve this, the risks posed by the main challenges faced by the city must be analysed. These challenges may be socio-economic (lack of access to housing, impact of tourism, etc.), technological (guaranteed supply of basic services, outages in the distribution network, etc.) or natural (torrential rain, droughts, etc.). Within the last category, the impact of climate change on the city must be identified and adaptation measures designed, in particular nature-based solutions.

Managing the resilience and adaptation to climate change of a complex urban system like Barcelona involves overcoming challenges but also presents opportunities.

- **Barcelona has been working on becoming a resilient city for years.** The city's approach to urban resilience has evolved over many years. Initially, plans and projects were defined for specific fields, without permanent instruments for intersectoral coordination. However, after observing a series of critical scenarios (particularly in terms of infrastructures and services), cross-cutting work with all the players involved (in the public and private sectors) and a holistic, systemic vision of the city was identified as a key objective.
- **Cities are extremely vulnerable to these risks as a result of high density populations and the related services.** Specifically, Barcelona has become one of the economic drivers of southern Europe and it is the heart of one of the most populous metropolitan areas on the continent. That, added to an economy that is heavily geared towards the service sector, has led to a high occupation of space, putting a burden on urban services and posing significant challenges as regards ensuring the city's functionality, as well as the security and quality of life of people living in and visiting the city.
- **Barcelona is at considerable risk on account of its geographic location.** Barcelona's population is exposed to different extreme climate impacts that are a feature of the Mediterranean climate (droughts, heat waves, flooding) but made worse by climate change. The large green space of Collserola will be affected by the increased risk of forest fires and drought, which, in turn, may compromise the guaranteed supply of water, which is basic for the city to function, as well as maintaining its green infrastructure and environmental services, among other things.
- **Heat affects the most vulnerable population.** Climate change does not affect everybody in the same way: disadvantaged groups and the homeless are particularly vulnerable to its effects. More specifically, the elderly are most at risk. It is particularly important to keep this in mind as the number of elderly residents in the city is gradually growing. Likewise, the death toll amongst infants aged under one increases by 25% on days of extreme heat.
- **There is a risk that the population will fail to adapt** due to a lack of knowledge regarding the effects of climate change, so communication, awareness raising and education activities are key.

2.2 General context and current situation

Urban resilience is the capacity of a city to prevent, or, when faced with unavoidable situations, minimise the impact of natural and anthropic dangers it is exposed to, whether they be regular episodes or stressful situations spread over time, and recover in the shortest possible time, in order to maintain its essential functions. In that regard, increasing Barcelona's resilience will be key as regards adapting to the effects of climate change, in addition to other risks.

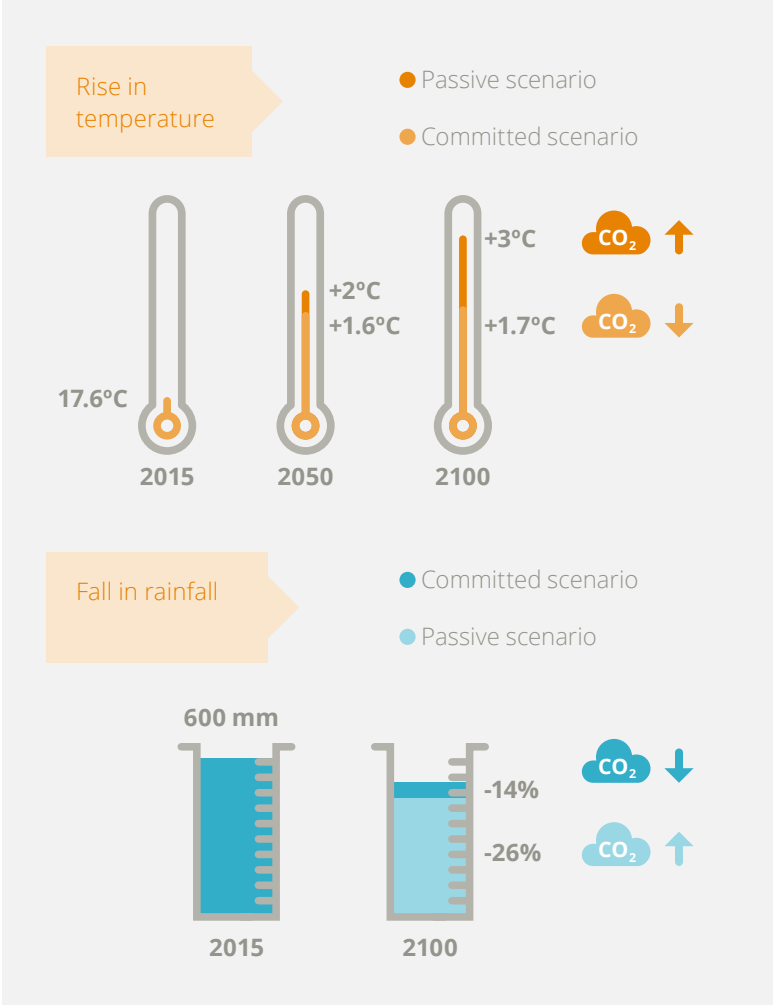
2.2.1. What will Barcelona's climate be like in the future?

Based on research conducted by the AMB, Barcelona Regional and the Catalan Meteorological Service have analysed how the climate in the region will change and what effects this will have on the city. This analysis has focussed on two possible scenarios:

→ **A more committed scenario** (RCP4.5) in which the 2015 Paris Agreement emission reduction targets are achieved. The concentration of GHGs would be higher than now at the end of the century but the increase would be reduced from 2030 onwards, in order to restrict the maximum rise in the overall temperature to 1.5 - 2 ºC.

→ **A more passive scenario** (RCP8.5) which represents a situation in which the targets set in Paris are not reached, so the GHG concentrations at the end of the century would be much higher than present levels. The increase in global temperature would be considerably higher than 2 ºC.

Barcelona currently has an average annual temperature of 17.6 ºC. If the projected increases in temperature caused by climate change prove correct, Barcelona may experience a 1.6 ºC increase in average annual temperature by the middle of the century and 1.7 ºC by 2100, in the case of global emissions being reduced in accordance with the Paris agreements (committed scenarios). This forecast could get worse if the current levels of emissions continue (passive scenario), producing a 2 ºC temperature increase by the middle of the century and 3 ºC by the end of the century.



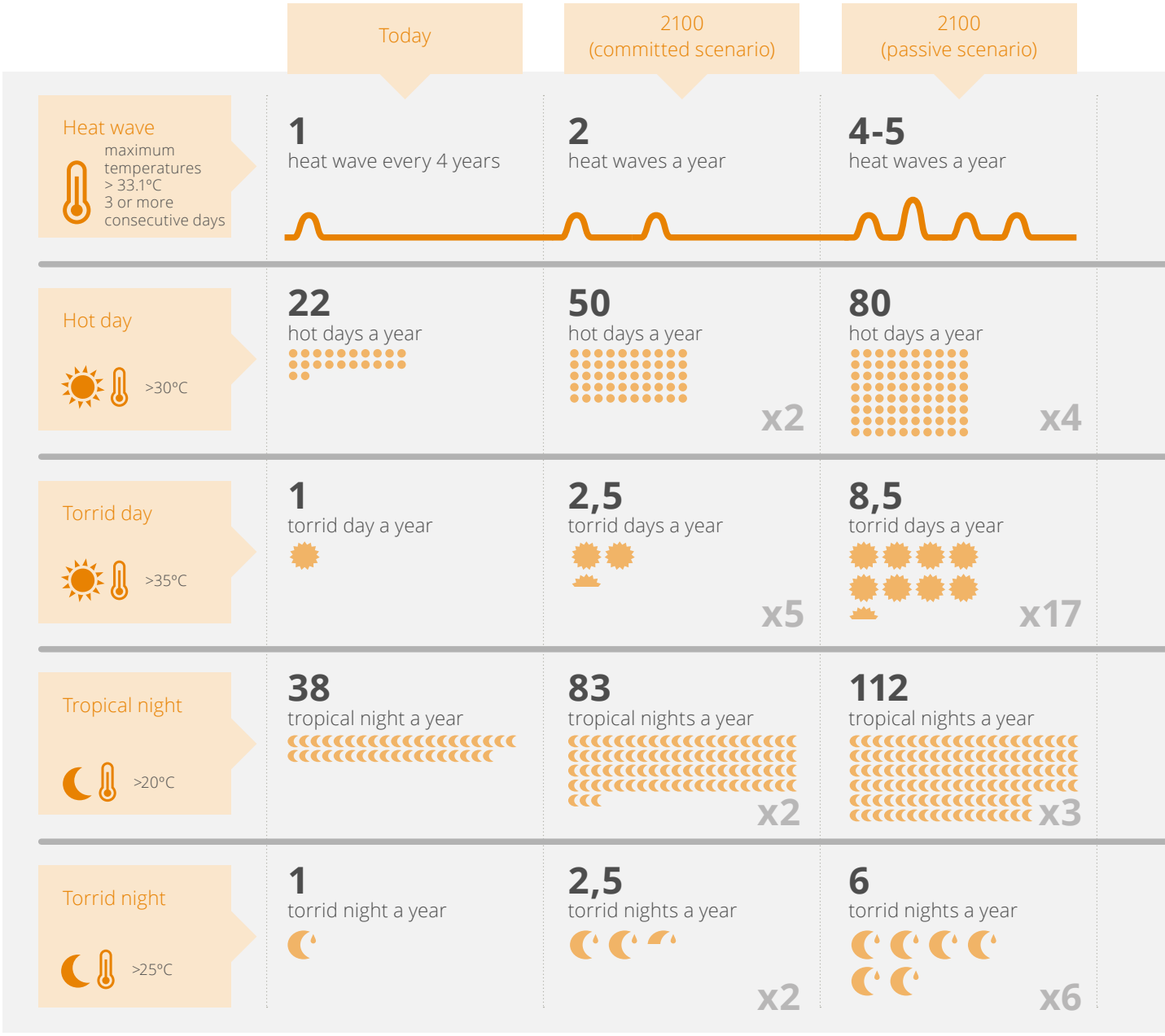
2.2.2. The main effects of climate change on Barcelona

The biggest climate change challenges that Barcelona will have to face are:

→ **Rising temperatures**. In Barcelona, a heat wave is considered to be a situation where maximum temperatures exceed 33.1 °C for three or more consecutive days. By the end of the century, in both the committed and passive scenarios, there is expected to be an increase in the days and nights with high temperatures and there are expected to be more heat waves, which will be more severe and last for longer.

Based on the most recent heat waves (2012 and 2015), the effect of the increase in temperature, which affects the city's neighbourhoods differently, has been studied and cross-referenced against the vulnerability associated with risk parameters (population aged over 75, energy performance of buildings, lack of vegetation and insufficient training). According to the map, the city areas most vulnerable to heat waves would be the district of Nou Barris and some parts of the Sants-Montjuïc, Les Corts and Eixample districts.

→ **Reduced availability of water**. The potential effect of climate change on the water cycle is a slight decrease in water resources and, in particular, a more significant variation in the availability of resources, increasing the



frequency of both droughts and flooding. A reduction of 12% in surface resources and a reduction of 9% in underground resources are forecast by 2050. On the other hand, it is estimated that demand for different city uses will increase by 4%. There will therefore be an additional need for water, estimated at 18 hm^3/year in Barcelona.

→ **Increased risk of floods**. It is expected that climate change will have two effects that may have an impact on the city's flood potential: the change in rainfall, with an increase in intensity and more extreme rainfall events, and an increase in sea level, which may affect the functionality of the sewage system in the event of extreme events. Given these impacts and the current level of impermeability, the system is expected to overflow at some points under both future scenarios. Based on three factors (capacity of the sewage system, slope of the terrain and basin area), the areas most at risk of flooding have been identified as Poblenou, Eix de la Diagonal, Sant Andreu, Badal and Sant Antoni.

→ **Shrinking beaches**. Given the increase in sea level and the frequency of extreme events, an increase in flooding is forecast along with morphological changes to the beaches and a greater exposure of port infrastructures. By 2100, the increase in the sea level on our coast is expected to remain at 0.46 m under the committed scenario and 0.64 m under the passive scenario. If we take into account the effect of the tide and changes in the wind and atmospheric pressure, the values would be 1.15 m and 1.33m respectively. This may lead to all the city's beaches shrinking. In some cases, such as Sant Sebastià, the beach may almost disappear, whilst others would suffer reductions of 30-46% in their surface area.

2.2.3. Other impacts that climate change has

The impact of climate change has also been analysed with regard to the following aspects:

→ **Air quality.** The projections made so far show an increase in the annual concentration of the three pollutants analysed. PM_{10}, NO_2 and O_3. The increase in the number of days of high concentration would be most significant in terms of PM_{10} particles (up to 41% in the committed scenario and 60% in the passive scenario). In terms of NO_2, the increase would be average in both scenarios (22%), with the impact most noticeable in the summer months. The increase in O_3 is expected to be low, 12-13%.

→ **Heat island effect.** Currently, the most intense and most frequent urban heat-island effect in Barcelona occurs at night and during winter. Urban monitoring stations register temperatures up to 3ºC (annual average) higher than those outside the city but differences of as much as 7 to 8ºC have been observed. Climate change will intensify the heat-island effect, as it will increase exposure to episodes of high temperatures and heat waves, with more serious consequences. To mitigate this effect, increasing greenery is essential on account of its thermal regulating role.

→ **Energy flows.** If we take all the sectors into account and consider there will be no variation as a result of climate change, Barcelona would be capable of reducing energy consumption by 6.7% in the committed scenario and 7.3% in the passive scenario. Despite the overall reduction, a change in the public's consumption patterns is forecast with an increase in the demand for electricity, mainly due to the need for air conditioning linked to episodes of high temperatures as well as new consumption linked to e-mobility.

→ **Biodiversity.** Global warning and the lengthening of drought periods may have an impact on vegetation. Plant phenology has already been affected and the scarcity of water intensifies competition among plants, which may suffer water stress, loss of vitality and greater vulnerability to pests and epidemics. In the case of fauna, these changes could affect particularly vulnerable species, namely, fish, amphibians and butterflies. In contrast, certain pests (mosquitoes, cockroaches, monk parakeets and rodents) are increasing in number, harnessed by the change in climate conditions, in addition to certain species of mosquito that transmit diseases such as dengue fever, Nile fever, Zika or chikungunya. In general, all these changes could contribute to the simplification of ecosystems and therefore reduce biodiversity.

→ **Forest fires.** Climate projections show there will be an increased fire risk in the Mediterranean region. Around Barcelona, there are other factors associated with human activity, urbanisation processes and changes in land use that bear the main responsibility for fires. Given the rise in temperatures and reduction in rainfall caused by climate change, leading to increased water stress and more highly combustible, there will be an increase in fire risk. The areas with the biggest risk of fires are mainly on the Barcelona side of Collserola (Vallvidrera, Tibidabo i les Planes, Horta, Canyelles and Torre Baró).

→ **Impact on infrastructures.** After the beaches, the sanitation and transport systems are the infrastructures that could be most affected by increased flooding risks (river, urban, due to a rise in the sea level or sea storms) or fires.

2.2.4. The Barcelona resilience model

Barcelona has been actively working on becoming a more resilient city since 2009, when it began to implement projects to reduce the weaknesses detected in infrastructures and urban services. These weaknesses were made particularly evident in 2007 as a result of a series of critical risks (risk of extreme drought, outages in train services, power outages, etc.) by the resilience committees. Organise in sectoral working groups, resilience committees develop specific projects to reduce the weaknesses identified. Each improvement project, in addition to defining goals and an action plan for achieving them, must establish a monitoring and improvement system to assess the corresponding degree of achievement.

The work done has generated a working methodology based on active, coordinated participation by all the public and private sector players involved in reducing risk and ensuring the city continues to function and turned Barcelona into a global city pioneer, with the creation of the Urban Resilience Department in 2014. The Department, which reports to the Urban Ecology Directorate, is based on three pillars which constitute its three main lines of action and correspond to the three phases that make up the continuous improvement cycle for creating resilience: risk management, through the Operations Centre; risk analysis, through the resilience analysis and information management platform, and risk reduction, through the resilience committees.

2.3 Measures implemented to make progress on resilience and adapting to climate change

The majority of impacts caused by climate change in Barcelona are existing phenomena that will get worse. Consequently, for some years now, Barcelona has been actively working on becoming a more resilient city, which guarantees the safety and quality of life of all its residents by incorporating climate change in city planning and management.

2.3.1. Improving knowledge and governance

Improving knowledge in terms of resilience and adapting to climate change

As part of the preliminary work for drawing up the Barcelona Climate Change Adaptation Plan, a benchmarking exercise was carried out in 2014, generally analysing the impacts, effects and challenges facing the city and in particular exhaustively analysing the urban strategies for adapting to climate change of 32 cities worldwide.

This analysis was supplemented with a report ⊕ identifying the policies, plans and programmes that the city was already putting into practice to adapt to climate change.

Finally, in order to draw up the Climate Plan and in cooperation with Barcelona Regional, the future impact of climate change on the city ⊕ has been analysed and the main weaknesses identified. The conclusions of the heat wave study have been particularly relevant. A heat risk map has been produced, identifying the most vulnerable areas considering the population, socio-economic and urban characteristics of buildings.

Barcelona's urban resilience strategy

In 2016, the Council approved the government measure on urban resilience ⊕ that encompasses the principles of the Barcelona resilience model and the series of actions that are being carried out within this framework, governed by the following strategic objectives:

- → To integrate the resilience principles in all city transformation, management and maintenance projects and processes.
- → To reduce the city's weaknesses through preventive actions that eliminate the causes or mitigate the impact of stresses and disturbances.
- → To provide the city with appropriate mechanisms for the early detection and evaluation of risks.
- → To work on improving the response capacity and minimising the impact and recovery time.
- → To provide useful information and tools to assist the decision-making process.

Resilience Atlas

The Resilience Atlas collates, organises and provides municipal experts with territorial information on Barce-

lona that is considered as being of general interest, in order to contribute to improving knowledge of the city and facilitating its use as a tool in decision-making processes as well as a basis for future studies. Maps generated by City Council-driven studies and geared towards planning, analysing weaknesses, or initiatives for compiling descriptive territorial information, among other things, will be published in this Atlas. The first content published in it were the results of the Barcelona Climate Change Impact Study.

New role of the Operations Centre

Since its incorporation into the Urban Resilience Department, the Operations Centre has become a key element in the resilience creation process. Within this context, it takes on a new strategic role as the coordination and communication hub in managing any incidents or critical situations the city may face for the various players and operators engaged in managing urban services.

2.3.2. Working with city networks to exchange experiences

Exchanging knowledge with other cities

Knowledge is exchanged by participating in international projects and networks of cities and multilateral bodies that make it possible to share experiences and information, such as the following:

- ICLEI with the Cities Adapt, Resilient Cities ⊕, Open European Day ⊕.
- C40, network of cities committed to the fight against climate change. Recently, Barcelona also adhered to the Women4Climate ⊕ programme.
- United Nations International Strategy for Disaster Reduction (UNISDR), with the "Making Cities Resilient" ⊕ campaign.
- The 100 Resilient Cities ⊕ programme, as part of which Barcelona has access to the tools, technical advice and other resources for producing a city resilience strategy.
- The UN-Habitat City Resilience Profiling ⊕ programme, with headquarters in Barcelona, which provides local and national governments with the tools and methods needed to assess weaknesses in urban environments that contribute to defining and implementing resilience action plans. In collaboration with this programme, "Barcelona's experience in resilience" (February 2015) and two Resilience Weeks (March 2016 and November 2018) have been organised as meeting spaces to reflect on and share knowledge and best practices with cities, experts and the main multilateral organisations and bodies that promote resilience on a global scale.

Participation in the RESCCUE project

Since 2016, Barcelona, along with Bristol and Lisbon, has been taking part in the EU project RESCCUE ⊕, RESilience to cope with Climate Change in Urban arEas. This project seeks to improve our knowledge about the impact of climate change on urban services, with a multi-sectoral approach, so cities can prepare for the challenges this poses.

Over the course of four years, Barcelona will study the impacts generated by climate change, particularly those related to water, and will analyse its impact on the city and urban systems, considering possible interdependencies and cascade effects.

2.3.3. Planning to minimise impacts caused by climate change

Heat wave action protocols

In 2004, Catalonia approved the Action Plan to Prevent the Effects of Heat Waves on Health (POCS) ⊕. Implemented each summer, it enables potential meteorological risk situations to be foreseen as far as possible in advance, which makes it possible to minimise the negative effects of heat waves on health as well as coordinate existing measures and resources to overcome potential heat waves.

In the PEEM for Heat Waves, the Council includes various measures to protect people who are vulnerable to the consequences of extreme temperatures. The heat wave action protocols are automatically kept at the preventive stage from 15 June to 15 September.

- Staff from the Council's primary-care social services, home-care teams and homeless people care centres receive information and training.
- The general public are informed about what a heat wave is and general recommendations to avoid their effects are issued.
- The census of people and families at risk and that of vulnerable people are updated.
- The list of care resources and air-conditioned day centres is updated.
- Vulnerable people are informed of the steps they need take to protect themselves from the effects of a heat wave.
- A 24-hour helpline to provide information to those who call, run in coordination with the medical services when health problems are detected, goes into service.

Prevention and action plans in the event of forest fires

The Forest Fire Prevention Programme (PPIF) in the Barcelona Metropolitan Area works on two main lines: passive prevention and active prevention. The first seeks to reduce the vulnerability to fire and decrease the likelihood of a fire starting by planning and taking action on factors that cause fires through awareness-raising and monitoring campaigns and on the characteristics of the land. The second defines a weather warning system with fixed, mobile and immediate intervention activities, plus coordination activities in cooperation with other services.

Barcelona also has a municipal emergency action plan (PAEM) for forest fires. This plan includes self-protection plans for the ten neighbourhoods located within or around Collserola. These plans establish cooperation protocols between local residents and the emergency services to coordinate the necessary actions in the event of a fire.

Conservation of species vulnerable to climate change

In Barcelona, there are certain species of fauna that are particularly sensitive to climate change (amphibians, butterflies, bats, birds, etc.),so various steps are being taken to help conserve them: introducing tree pits, naturalising pools, planting more sustainable decorative flora, installing new biodiversity structures, creating spaces that are

Bio-trunk in the Jardí de Petra Kelly, Montjuïc.

of particular interest to biodiversity, etc. *(see Section 4.3.2, "Naturalisation of the city").*

Monitoring and control of pests and arbovirosis

Climate change may facilitate the presence of certain pests, such as cockroaches, mosquitoes, monk parakeets and rodents. To avoid this, comprehensive control measures are being implemented, such as applying a water management policy aimed at reducing or eliminating possible mosquito sources from public roads and the sewage system; monitoring mosquito populations to detect the possible arrival of invasive mosquitoes and monitoring biting activity in unfavourable periods to detect a possible change in the seasonality of biting (for example, an increase in temperature).

In addition, rising temperatures and humidity variations

could affect some insect populations and increase the risk of certain arboviruses (such as dengue, yellow fever, West Nile, chikungunya and Zika viruses) being transmitted. Monitoring and control protocols have therefore been established.

Thanks to the Mosquito Alert app, anybody can report possible tiger mosquito or yellow fever mosquito sightings and their breeding sites in public spaces by submitting a photo. The photo picks up the GPS position and a team is sent to investigate. Since 2014, a map ⊕ has been published that can be used to query and export all sightings received to date.

Actions to guarantee the water supply and manage flooding

→ Municipal water saving measures *(see Section 9.3.1, "Saving and efficiency to guarantee the water supply")*

→ Raising awareness amongst the population to promote water saving *(see Section 9.3.1, "Saving and efficiency to ensure the water supply")*

→ Drought Status Protocol *(see Section 9.3.1, "Saving and efficiency to guarantee the water supply")*

→ Technical Plan for Harnessing Alternative Water Resources *(see Section 9.3.2, "Harnessing alternative water resources")*

→ Management of floods using sustainable urban drainage systems, with the network of underground rainwater retention tanks *(see Section 9.3.5, "Flood risk and run-off management")*

→ PAEM on indequate drainage/flooding *(see Section 9.3.5, "Flood risk and run-off management")*

Actions to guarantee the power supply

To guarantee access to basic power services and prevent power outages, Barcelona has a power outage specific PEEM and gas outage specific PEEM for cases involving a public electricity distributor, which features ten energy advice points and the Programme to Promote Solar Power Generation, in addition to other measures *(see Chapter 1 "Energy and climate change mitigation").*

2.3.4. Progressing with the Climate Plan in terms of rolling out adaptation actions

Climate refuge spaces in the city

Barcelona has dedicated infrastructures and green spaces which, if a heat event occurs, can serve as climate refuges, i.e. a place where residents, particularly the most vulnerable, can go and enjoy better conditions. A preliminary analysis of the potential of these infrastructures and green areas suggests that they are distributed relatively homogeneously across the city, with the exception of certain areas in Zona Franca, Sarrià-Sant Gervasi and Eixample. Currently, work is ongoing to identify all these spaces and the need to enhance the existing services or generate new ones to guarantee an adequate degree of coverage for the entire city (100% of the city less than 10 minutes on foot from a climate refuge space).

The Climate Plan, the best plan of the major European cities

The Covenant of Mayors for Climate & Energy has granted the "Covenant Cities in the Spotlight" award to Barcelona's Climate Plan in the major cities category. The Climate Plan has been praised for the integrity and effectiveness of the process and the importance of taking a general, cross-cutting approach that integrates migration, adaptation and climate justice and that seeks inter-generational implementation.

2.4 Future goals and measures

Although Barcelona has been working towards becoming a resilient city and adapting to the impacts resulting from climate change for a number of years, as can be seen in the large variety of measures that have been implemented, the city now as two instruments that will enable it to integrally manage resilience and adaptation to climate change.

2018-2030 Barcelona Climate Plan

In response to the commitment the city made by adhering to the Covenant of Mayors for Climate & Energy in 2017, Barcelona has drawn up a Climate Plan ⊕, a new roadmap to tackle climate change up to 2030.

The Climate Plan establishes strategic goals and measures in the short-term (2018-2020) and in the medium to long term (2021-2030) structured around four strategic pillars: mitigation, adaptation and resilience, climate justice and promoting citizen actions. To achieve these, the Plan features eighteen lines of action divided into five different areas:

- → **People first:** the well-being of residents.
- → **Starting at home:** improving efficiency in buildings.
- → **Transforming communal spaces:** transforming public spaces into healthy, biodiverse, efficient and inclusive settings.
- → **Climate economy:** uncoupling the quality of people's lives from economic growth, with a circular vision that makes the most of resources and avoids generating waste and emissions.
- → **Building together:** in collaboration with an informed, critical, proactive and empowered citizenry.

To decrease vulnerability and increase the city's resilience to the undesirable effects of climate change, the Climate Plan has set the following targets for 2030:

- → Increase green space by 1.6 km^2 (1 m^2 more greenery per current inhabitant) and achieve 34,100 m^2 of green roofs, walls and façades.
- → Increase tree cover by 5% (2037).
- → Increase adapted tree species from 30% to 40%.
- → Have 100% of the population at least 10 minutes on foot from a climate shelter (facilities and urban parks that provide good thermal comfort conditions and which could shelter sensitive people in the event of heat waves).
- → Have one water garden per district
- → Achieve domestic drinking water consumption of less than 100 litres per inhabitant a day.

→ Increase the use of underground water by 2.7 hm^3.

→ Achieve 18 hm^3 additional potable water in collaboration with other authorities (2050).

To achieve these targets, the Plan has set out a number of measures. The most noteworthy resilience and adaptation to climate change actions are as follows:

→ Identify existing and potential **climate shelter** spaces. Map the degree of cover to ensure territorial fairness and take into account the areas identified as the most vulnerable to heat before creating new ones.

→ Create **water gardens** (sprinklers, accessible fountains, lakes, swimming pools, etc.). These gardens will have to be assumable as regards water consumption and be spread equally around Barcelona.

→ Create the **"Barcelona, city of shade"** programme, for intervening in public space to create more shaded areas, by increasing the green cover or installing urban furniture, preferably multifunctional (e.g. photovoltaic pergolas). Itineraries must be identified and mapped and the creation of shade in private open spaces encouraged.

→ Take action to **increase the reflectance index** of city pavements and terraces and help to mitigate the heat-island effect.

Schools in the city will be climate refuges

The municipal project entitled "Blue, Green & Grey Adapting Schools to Climate Change" has been acknowledged by the European Commission as an innovative urban action and will receive an ERDF subsidy of €4 million. The plan, which runs from 2019 to 2022, envisages turning schools into climate refuges by means of water, greenery and renovation-related measures to mitigate the impact of heat in summer.

The proposal, which will first be applied as part of a pilot test involving ten schools, includes the renovation of playgrounds to increase green and water spaces and improve energy efficiency, so these schools are ready to cope with the summer heat. Furthermore, the city's schools will remain open over summer as climate refuge spaces for all the city's residents.

Resilience strategy for the city

In order to provide a framework to all these lines of action, bring together the working methodologies and resources that define the resilience model for the city and define a medium to long term roadmap, work is currently under way on preparing the resilience strategy. At a global level, the strategy is in line with the sustainable development goals, the New Urban Agenda and the Sendai Framework for Disaster Risk Reduction, promoted by the United Nations.

It is important for the strategy to be related to a large number of sectoral programmes, actions and measures being promoted across different areas of the Council and that they are interlinked and complement one another from the holistic perspective of vulnerability and risk management offered by resilience. The resilience strategy will be supported by the Climate Plan and include measures to overcome the main impacts, pressures and challenges faced by the city on social, economic, urban infrastructure and service levels.

The strategy will be developed as part of a co-produced approach, which will require the involvement of key actors from both the City Council and external agents, spearheaded by the Resilience Department. It will benefit from collaboration with City Resilience Profiling at UN-Habitat and 100 Resilient Cities.

Women4Climate

As a result of the City Council's adhesion to the Women4Climate programme organised by the C40 network, it will offer the Women Mentoring Programme, specially designed for institutions run by women that want to become established and grow. The programme, which is voluntary for both mentors and mentorees, will consist of six hours of mentoring.

It will be promoted across the entire More Sustainable Barcelona network through an informative session to identify possible candidates working on issues related to the Climate Plan.

Mobility and urban transport

Towards safer, healthier, fairer, smarter and more sustainable mobility

Mobility and urban transport

Vision of the future

Progress towards a model of safe, healthy, fair, smart and sustainable mobility

Current situation

Daily journeys

8,225,347

74.4 % Ecomobility (public transport + bike+ on foot)

64.2 %
are internal journeys

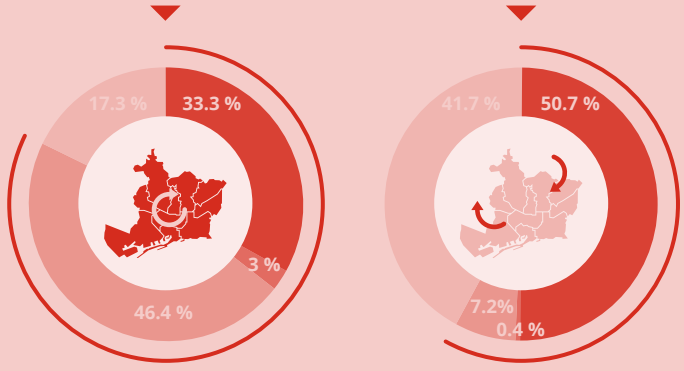
35.8 %
are connecting journeys

Public transport

Bike

On foot

Private vehicles



83.1 % Ecomobility

59 % Ecomobility

Lines of action

Promoting cycling "Expansion of bicycle lanes" "Bicycle-friendly buildings"

Street pacification "Superblocks" "Expansion of surface area for pedestrians"

Connectivity "Orthogonal bus network"

Containing private vehicles "Bus-HOV lane" "Low emissions zone" "Park & Ride"

Promoting electric vehicles "Free recharging stations" "Electrification of the municipal fleet"

3.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to progress towards a model of safe, healthy, fair, smart and sustainable mobility. It wants to move towards a city where public spaces are dedicated to people once again. To this end, it is key to increase the areas dedicated to those travelling on foot and by bicycle, promoting public and collective transport, and reducing the space dedicated to private motor vehicles, as proposed in the superblock model. At the same time, the use of electric vehicles must be encouraged, as must the switch to more efficient means.

On this path to sustainable mobility, it is essential to bear in mind geographic, territorial and economic barriers. A number of these barriers represent challenges that must be overcome and others, opportunities that must be harnessed:

- **Barcelona is surrounded by mountains, rivers and the sea.** The Catalan Coastal Range, the Llobregat and Besòs rivers and the Mediterranean Sea determine the development of transport infrastructures.
- **It is Catalonia's capital and the heart of a large metropolitan area.** The metropolitan area is made up of a system of polarities of moderate-sized cities, with significant economic activity and high population density. In recent years, there has been rapid growth in mobility needs between Barcelona and the wider area, so it is essential to improve the sustainability and efficiency of these connecting journeys.
- **It is a stop-off city.** Its strategic location, and the fact that it has one of the main airports and ports on the Mediterranean coast, together with the high level of economic activity, have made Barcelona a stop-off city with a high level of traffic. In that regard, the self-protection plans for mobility and transport infrastructures must be adapted to the evolution of projected future climate scenarios and the potential risks that derive from them.
- **It is a dense, compact and complex city.** As such, Barcelona is defined by different types of activity concentrated in a limited amount of space. This fact, in addition to its mild climate, facilitates journeys on foot or by bike.
- **It is one of Europe's main tourist destinations.** Tourist mobility represents between 10% and 15% of internal journeys and most tourists go round on foot or use public transport. Tourist demand must therefore be included in mobility planning and management.
- **Managing Barcelona's mobility network is a complex task.** The network's organisational structure involves various players – competent public authorities, infrastructure owners and service owners – that need to coordinate with one another.
- **Mobility has a huge environmental impact on the city.** As is the case with many European cities, the transport sector is the main source of atmospheric pollution, GHG emissions and noise pollution. It also represents a very important source of energy consumption. Reducing travel using private vehicles and making those on the roads as clean as possible is a priority.
- **In recent years, bicycles have become much more popular,** thanks to the expansion of the bicycle lane network and adapted services, efforts to promote this means of transport and the expansion of Bicing public bike-hire services. However, cycling faces two main challenges: theft and coexistence cyclists, pedestrians and drivers.

3.2 General context and current situation

As is the case of many European cities, the main source of atmospheric pollution in Barcelona is attributable to the transport sector. It is also the main source of GHG emissions and noise pollution and it represents a very important source of energy consumption. The transport of people and goods has become the second largest consumer of final energy, accounting for 27.3% of the total. Furthermore, the transport sector is highly dependent on petrol, as electric vehicles are still few and far between, although hybrid cars are gaining a more important presence in the city. Four per cent of vehicles have an "Ecolabel" (essentially, petrol hybrids) and only 0.3% are classed as being "zero emissions" (electric vehicles).

Different players are involved in the organisational structure of mobility, and cooperation between them is essential to guarantee safe, healthy, fair, smart and sustainable mobility. The city boasts a comprehensive public transport structure, both above ground – buses (neighbourhood, intercity and tourist), trains (Renfe Rodalies, regional and national, trams, taxis and funicular railway – and underground – metro and Ferrocarrils de la Generalitat de Catalunya).

In terms of responsibility for road infrastructures, the State is responsible for the core State and European network, the Generalitat of Catalonia for the core Catalan network, and the Barcelona Provincial Council for the local network. The Barcelonès County Council performs overall maintenance work on Barcelona's ring roads, whilst the City Council is responsible for the traffic management and road safety, including that of pedestrians, cyclists and goods distribution.

The transport sector in Barcelona is responsible for:

30,6% of the city's GHG emissions

Almost 60% of NOx emissions and particles

More than 80% of noise pollution in the city

The public transport networks of Barcelona are managed by 4 different administrations

Competent authority	Infrastructure owner	Service owner
Catalan Government	Metro, FGC, Tramvia	FGC (includes 7 Renfe Rodalies lines), intercity buses
Barcelona Metropolitan Area (AMB)		Metro, Bus Barcelona, Bus AMB, Taxi
State Government	State Renfe network	Renfe (State, regional and 6 Rodalies lines)
Metropolitan Transport Authority (ATM)		Tramvia

3.2.1 Different methods of transport for internal and connecting journeys

According to data from 2017, there are 8.23 million journeys a day in Barcelona, of which 64.2% correspond to internal journeys and 35.8% to connecting journeys (between Barcelona and other locations).

Most internal journeys are by bike or on foot, accounting for 49.4% of the total, while most connecting journeys are by public transport, accounting for 50.7%. Private vehicles are used much more in connecting journeys (41.7%) than in internal journeys (17.3%).

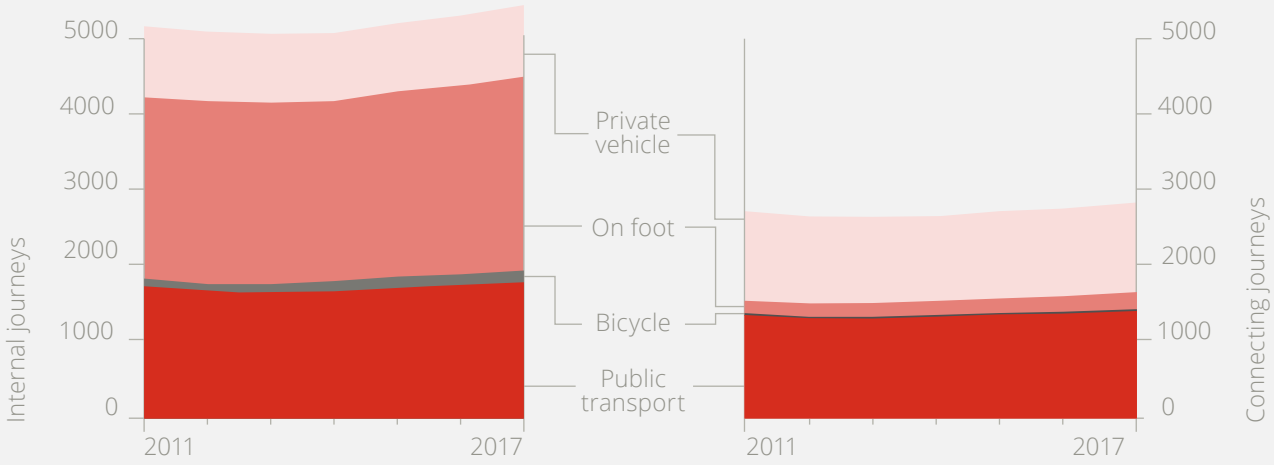
The total number of journeys has continued to increase since 2013, when the minimum for the period in question was recorded. In the case of journeys by bicycle, the upward trend has been constant since 2011.

The weight of eco-mobility (journeys on public, non-motorised transport, on foot or by bike) in total journeys has increased slightly after a number of years of stability, although it remains under the target established in the 2013-2018 Urban Mobility Plan (85.1%). Whilst it is increasingly close to the target (83.1%) in the case of internal journeys, there is still some way to go in terms of connecting journeys (59.0%).

3.2.2 New mobility habits

Compared to 2012, journeys on foot have increased by 4%, accounting for 32.4% of internal and connecting journeys. New spaces have been created that prioritise pedestrians, such as the superblocks in Poblenou and Sant Antoni and various streets in the city have been traffic-calmed.

Furthermore, the use of bicycles has increased, reaching a total of 180,000 journeys per day, 45% up on 2012. The expansion of the bike lane infrastructure has played a significant role in this increase, growing to 209 km in



Since 2008 private transport has gone decreasing progressively, both in the internal journeys and those of connection.

2018, as has the number of on-street cycle parking spaces, up by 57% (34,988). As for the public bicycle service, Bicing, the number of journeys remains stable, at 13.28 million a year.

The use of public transport has also grown slightly. Compared to 2012, the number of journeys on public transport has increased by 6.1%. This increase has been accompanied by improvements to the metro and bus network: the length of the metro lines has increased by 16% (to 119 km) and bus lanes by 26.8% (201 km).

Journeys in private vehicles have increased by 1.5% in internal journeys and 2.8% in connecting journeys. By contrast, the total number of passenger vehicles in Barcelona has dropped (9.7%) between 1999 and 2015. Likewise, the number of lorries and vans has decreased (11.5%), whereas the number of motorbikes has increased significantly (55%).

One of the main problems to be addressed is the large number of private motor vehicles on Barcelona's streets. Despite the fact that they only represent 26.1% of the journeys made by Barcelona residents, cars and motorbikes, whether in traffic or parked, take up between 50% and 70% of the space on many streets. By contrast, the occupancy rate of cars remains very low (1.19 people/car).

As far as promoting electric mobility is concerned, the municipal electric fleet has increased by 67%, 450 electric vehicle recharging stations have been installed and

95% of residents have a free recharging station less than 2 km or 6 minutes away.

3 logistics platforms with electric vehicles have been set up.

The rapid proliferation and growing use of personal mobility vehicles (PMV) and cycles with more than two wheels is also worth highlighting.

The number of victims (deaths and serious injuries) caused by road accidents has increased compared to the last two years to 253 and is therefore above the target of 220 victims established in the Local Road Safety Plan (2013-2018).

The vehicle fleet of the Guàrdia Urbana has 60 electric motorcycles.

3.3 Measures implemented for more sustainable mobility

The measures implemented in recent years are aimed at giving greater prominence to pedestrians and cyclists, promoting the use of collective public transport and reducing the use of private vehicles, with the goal of improving the quality of the city, road safety and the efficiency of the entire mobility system.

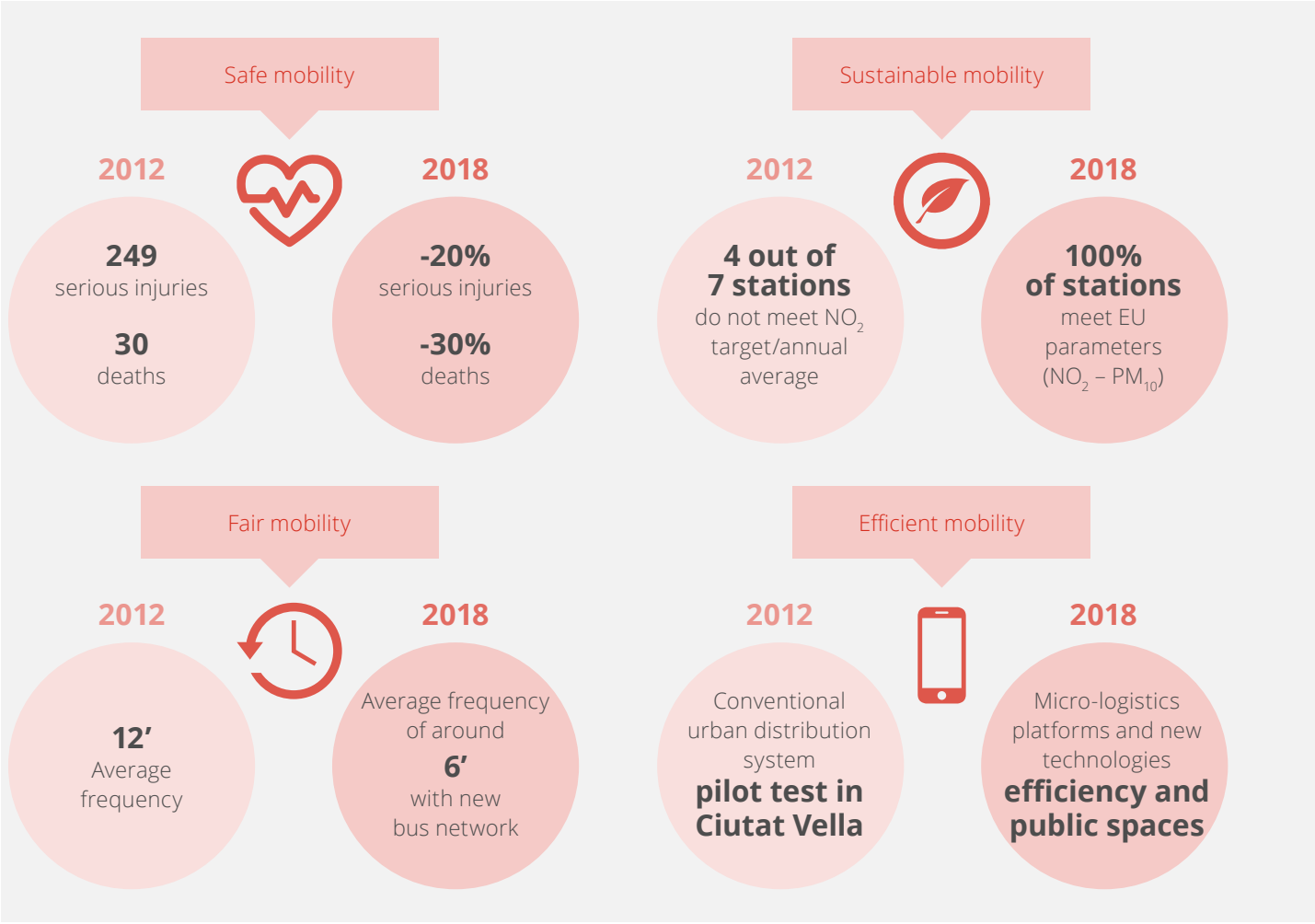
3.3.1 Towards safe, healthy, fair, efficient and sustainable mobility

2013-2018 Barcelona Urban Mobility Plan (UMP)

This plan ⊕ has served as a planning instrument to enable a series of actions to be taken in order to move towards a safer, fairer and more sustainable and efficient collective mobility model. It has been structured around four pillars, each of which has been assigned quantitative targets:

→ **Safe mobility:** reduce the number of deaths by 30% and the number of injuries by 20% compared to 2012.

→ **Sustainable mobility:** meet European Union criteria for NO_2 and PM_{10} at all stations, and reduce the num-



ber of journeys in private vehicles by 21% compared to 2013.

→ **Fair mobility:** increase bus frequency by approximately 6 minutes on average.

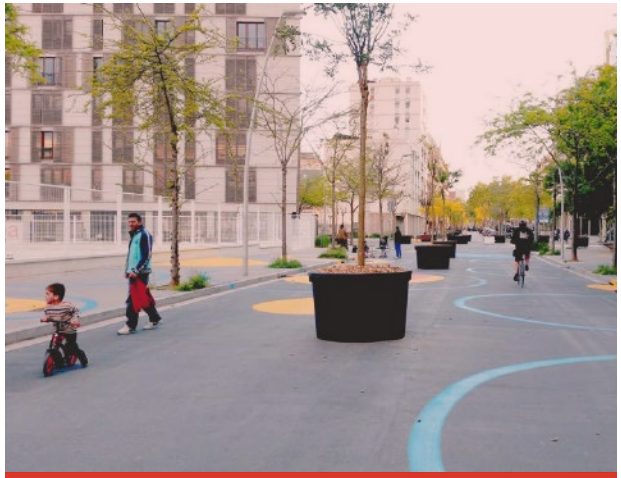
→ **Efficient mobility:** create micro-logistics platforms and new technologies to distribute goods in the city.

3.3.1 A Barcelona for pedestrians and cyclists

The superblock model: recovering public spaces for people

Barcelona is looking to combat the levels of atmospheric pollution, traffic-generated noise, road accident rates and the lack of greenery to become a more inhabitable and healthier city. Many of these problems are defined by the space dedicated to private motor vehicles, which accounts for 60% of the public highway.

To reverse this situation, the "Let's fill the streets with life. The implementation of superblocks in Barcelona" programme is a tool for reorganising the city in such a way that priority is given to pedestrians, followed by cyclists and public transport, in order to turn the city into a place where the streets and squares serve as meeting and recreational spaces for cultural, economic and social exchange.



Poblenou's superblock received an award at the 2018 European Prize for Urban Public Space.

Superblocks ⊕ have been defined as urban units formed by joining different blocks together, where streets are traffic-calmed to recover public space for pedestrians, motor-vehicle access is restricted, and priority is given to sustainable mobility along with shared, safe, green spaces.

The first superblock was created in Vila de Gràcia, and since then, additional superblocks have been created in Poblenou, Sant Antoni, Les Corts and Horta. The implementation of each superblock includes a participatory process as part of which local residents and groups adapt the model to the specific characteristics and needs of the area.

More areas for pedestrians

Regulating vehicle access by installing pylons at the entrance to certain streets and creating "30 zones", where the maximum vehicle speed is 30 km/hr, are two measures introduced in Barcelona to pacify traffic and promote mobility on foot.

Compared to 2013, the spaces that prioritise pedestrians has increased by 41%, from 76.2 ha to 107.8 ha in 2017.

"School path, friendly space"

"School path, friendly space" is a participatory, city-wide project that promotes the idea of students having safe and friendly routes to take to and from school, without having to be accompanied by an adult. This represents an opportunity to develop student autonomy and shared civic responsibility, as well as recovering spaces where people can mix and share a value-based educational framework.

Currently, 103 schools have school paths, with a further 45 in the process of creating one. Since 2015, 43 schools have joined the programme and it is expected that 18 more schools will join before the end of the 2018/2019 academic year. The programme is due to be updated to include improvements as a result of an assessment performed in 2017.

Bicycle Strategy for Barcelona

Approved in 2015, it is a strategic instrument containing the actions to promote the use of bicycles to pick up from where the PMU 2013-2018 left off, with a target of increasing bicycle journeys by 67% compared to 2011. In order to achieve this, the following actions have been established:

- Expansion of the bicycle infrastructure by 209 km.
- Increase in on-street parking by 57% compared to 2012.
- Amendment to the Pedestrian and Vehicle Flow Byelaw to adapt it to the new situation in Barcelona with a notable increase in journeys by bike.
- In 2016, the Urban Ecology Manager's Office published the "Barcelona Bike Lane Design Manual", which defines the criteria for implementing bike lanes in order to improve the safety of pedestrians and cyclists, reduce conflict with pedestrians, improve the connectivity of new bike lanes and address awareness raising, regulation and design issues.
- Promoting the use of bicycles with the new Bicing service, which came into operation at the start of 2019: wider coverage, 24-hr availability, more bicycles in service (both conventional and electric) and mixed conventional and electric stations.

With the planned expansion of the bike network, 95% of the city's residents will have a bike lane less than 300 metres from their home.

- Improvements to public transport in terms of bicycle access and installation of Bicibox parking at certain metro stations.
- As part of Barcelona City Council's programmes and infrastructures, participatory, educational and promotional actions have been held on the use of bicycles, including "Let's campaign for safe, sustainable mobility" as part of the "More Sustainable Schools" programme, or the "Bike it to work" project as part of the More Sustainable City Council programme, to name just a couple. This programme also includes the certification of municipal buildings that can be accessed by bike as part of the "Bike-friendly buildings" campaign. To date, 7 municipal buildings have been certified and 20 are undergoing the certification process.

3.3.3 Promoting public transport: more bus lines for a more connected city

New orthogonal bus network

In 2012, the New Bus Network was rolled out with 5 new lines and, since then, this number has increased as part of successive implementation phases. This process ended in November 2018 with a total of 28 lines (17 vertical, 8 horizontal and 3 diagonal). This new, more linear set-up allows for faster and, therefore, more frequent journeys. Furthermore, it has made the network more intuitive and easier to use, more efficient and more connective with the rest of the public transport network.

This initiative has gone hand in hand with improvements to public spaces and accessibility, in addition to expanding the bus lane network by 38 km, creating a total network of 201 km. A wide range of actions have also been carried out to ensure priority is given to buses.

The New Bus Network has been popular among regular bus users, with numbers increasing by 7% since 2013.

Expansion of the metro network

The southern section of lines 9 and 10, connecting the city with the airport and the Zona Franca district respectively, have now been opened. With these, the metro network is now 119 km long and has 156 stations. Furthermore, following the opening of the L10 Sud line, the automatic driving network has risen to 33 km, equivalent to 27% of the network.

Improving accessibility

A wide variety of actions have been taken to guarantee and improve the accessibility of people with reduced mobility to collective public transport networks, for example, at the Putxet FGC station or the Barceloneta metro station.

3.3.4 Private vehicles, limited and sustainable

2016 Electric Vehicle Master Plan

Barcelona City Council has developed a strategic line of action to introduce electric vehicles into the city, thus promoting sustainable mobility and contributing to the reduction of GHG emissions and fossil fuel consumption, in addition to improving air quality and noise pollution.

Notable actions in this line include:

- → Free parking in green/blue zones for users of electric vehicles.
- → 75% reduction on the mechanically powered vehicle tax.
- → 450 public recharging stations, of which 125 are dedicated to motorbikes and 17 are fast charging stations.

As regards the internal plan, the promotion of electric vehicles is reflected in the municipal fleet: currently, 21% (594) vehicles are electric, of which 171 are cleaning and waste management trucks, and the 107 additions in 2017 represented 36% of all new vehicles. Worth special mention is the recent acquisition of 30 electric scooters by the Barcelona City Police Force (GUB), in addition to

the planned renovation of patrol cars, with 145 hybrid cars due to be delivered by the end of 2018. TMB has 4 electric buses and is in the process of carrying out a pilot test to replace diesel buses with hybrid and electric buses.

In this line, the City Council participates in the Live Barcelona platform, a public-private platform of entities involved in sustainable mobility that seeks to develop projects, strategic policies and new business models, and also create a knowledge network.

95% of residents have a free recharging station less than 2 km or 6 minutes away.

Implementation of the bus-HOV lane

Bus-HOV lanes seek to promote and enhance the efficiency of collective transport, whether public or private (high occupancy). These segregated and reversible lanes can only be used by buses, passenger vehicles with 2 or more occupants, vehicles with the Zero, Eco or C distinction (Euro 6 diesel), motorbikes and vehicles for people with reduced mobility. Since 2012, the Barcelona Metropolitan Area has had a bus-HOV lane on the C-58, starting on Avinguda Meridiana.

Park & Ride

Barcelona de Serveis Municipals (BSM) has four Park & Ride locations on the outskirts of the city (Plaça del Fòrum, Rius i Taulet, Sant Genís and Marquès de Mulhacén). This type of car park is set up close to public transport stations with a view to drivers parking their private vehicles and travelling to the city centre using public transport.

Promoting sharing services

Carsharing was first rolled out in Barcelona in 2005 and recently, other forms of shared mobility, such as motosharing and bikesharing have gained popularity. Members have access to a fleet of vehicles that are available when required, without having to own these vehicles. This system reduces the individual and social costs of mobility and, therefore, promotes the rational use of private vehicles and more sustainable mobility.

Given the increase in this type of service, the City Council is working on a regulatory framework to minimise the negative impacts deriving from occupancy of public spaces.

2013-2018 Barcelona Local Road Safety Plan

To achieve the road safety target set out in the 2013-2018 PMU, reduce the number of deaths by 30% and the number of serious injuries by 20% in 2018 and based on an exhaustive diagnosis of accident rates, a range of measures have been put into practice:

- → Maintaining urban roads in proper condition
- → Better signs and information on road works
- → Rollout of highway code campaigns and preventive measures
- → Detection of accident risk sites
- → Training actions, such as mobility councils for the elderly and "School path, friendly space".

Restricted circulation of vehicles in the low emission zone

Since December 2017, on days with NO_2 environmental pollution, from Monday to Friday, between 7 am and 8 pm, passenger cars without the DGT environmental label and vans prior to Euro1 cannot be driven in the Low Emission Zone within Barcelona's ring roads, an area of more than 95 km^2 that includes Barcelona and the municipalities in the ring-road area. And since December 2018, motorbikes and scooters have been included in this ban without distinction. From 1 January 2020, the restrictions shall apply to all vehicles without distinction.

In the event of a pollution episode, these restrictions are complemented by public transport enhancement actions: increase in the overall offer, T-aire, T-verda, ans so on *(see Chapter 6 "Local air quality").*

3.3.5 Towards goods delivery with less environmental impact

The distribution of goods and products people need in their everyday lives entails the daily circulation of a large number of vehicles in Barcelona. To reduce their impact, we are engaged in ongoing work along the following lines:

- Goods distribution by bicycle or electric bicycle
- Network of micro distribution platforms where cargo bikes play a leading role.
- AreaDUM: a pilot project involving a mobile app, AreaDUM, to control loading and unloading zones, has been carried out. Using this app, users can book the zone with details of the time at which it is free.

A pilot test has been carried out distributing goods on electric tricycles in Ciutat Vella.

3.3.6 New challenges posed by tourism in terms of mobility in the city

Tourism mobility strategy in Barcelona

This strategy ⊕, approved in November 2017, came about as part of the response to the challenges in terms of city management, as a result of the increase in the number of tourists visiting Barcelona and the expected increase in the medium term. Using the city tourist mobility diagnostics, actions have been established that must be applied and that develop the following strategic lines:

- Include tourism demand in mobility planning and management.
- Guarantee environmental sustainability.
- Ensure greater equality in the distribution of direct and social costs.
- Make tourism mobility compatible with everyday life.
- Respond to the territorial challenges in the destination.

3.4 Future goals and measures

The city has two key planning tools that will define the main strategic lines to be followed in the coming years.

3.4.1 Strategic mobility planning over the next six years

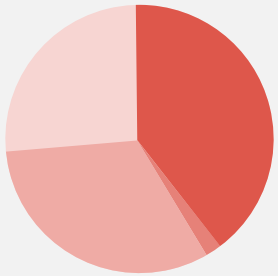
New Urban Mobility Plan for 2019-2024

Barcelona is in the process of drawing up the new Urban Mobility Plan for 2019-2024. This new plan proposes a change in the mobility model that follows the line of the 2013-2018 PMU as regards the main milestones: increase mobility on foot, generating safe and comfortable spaces for pedestrians, and sustainable methods of mobility, while reducing the use and presence of private motorised transport not only because of environmental pollution and the consequent health problems, but also due to the high rate of accidents and occupation of public space, as well as the harm they cause to the general public.

The 2019-2024 Urban Mobility Plan will be based on the following pillars:

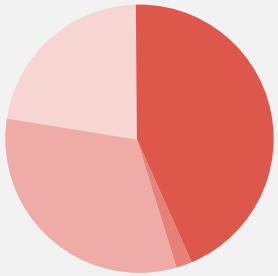
- → **Safe mobility:** reducing mobility-related accident rates.
- → **Healthy mobility:** promoting active mobility and reducing the atmospheric and noise pollution generated by transport.
- → **Sustainable mobility:** facilitating a modal shift to more sustainable modes of transport, increasing the proportion of clean, renewable energy consumption and reducing their contribution to climate change.
- → **Fair mobility:** boosting alternative uses of public roads; ensuring accessibility to the mobility system; ensuring fair mobility according to age, physical condition, gender, income and neighbourhood, and improving conditions for labour mobility and daily life.
- → **Smart mobility:** increasing the efficiency of transport systems and use of shared-use vehicles; incorporating new technologies into mobility management; improving mobility services by introducing mobility as a service technologies.

2016



- Public transport: **39,6%**
- Bicycle: **2,1%**
- On foot: **32,3%**
- Private vehicle: **26,1%**

2024 PMU target



- Public transport: **43,3%**
- Bicycle: **3,5%**
- On foot: **33,3%**
- Private vehicle: **20%**

MAIN MEASURES FOR EACH METHOD OF TRANSPORT

On foot

- → Expand and improve the surface area of traffic-calmed zones.
- → Improve pedestrian safety.
- → Promote the "School path" and sustainable, safe mobility to schools
- → Enhance and reassess pedestrian safety.

By bicycle

- → Extend and improve the network of bicycle routes and safe parking.
- → Improve the efficiency of the public bicycle service.
- → Promote the use of electric bicycles.
- → Promote public transport with access for bicycles.

Public transport

- → Consolidate the new bus network.
- → Use more sustainable vehicles in the public transport fleet.
- → Connect the tram networks.
- → Implement and assess the Tourism Mobility Plan.
- → Promote T-Mobilitat.

Private vehicle

- → Manage traffic applying environmental criteria.
- → Promote more sustainable and safe vehicles.
- → Increase the control of noise and air-pollutant emissions from vehicles.
- → Promote the roll-out of recharging points for electric vehicles.
- → Promote and regulate shared vehicle systems.

Urban distribution

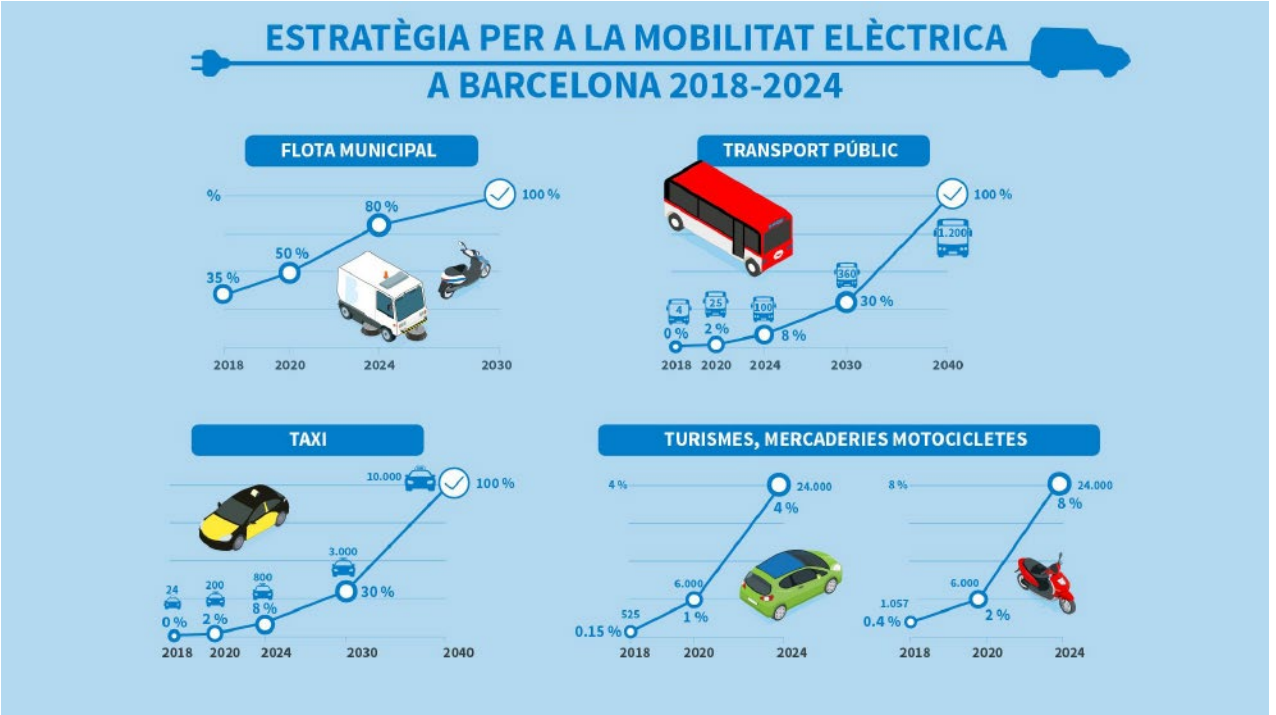
- → Consolidate the implementation of the last-mile micro distribution platforms.
- → Incorporate new technologies to enhance management.

2018-2024 Electric Mobility Strategy

Based on the targets of the 2013-2018 PMU and in line with the new 2019-2024 PMU, the City Council has established a roadmap to make progress with the roll-out of electric mobility in the city. Based on the diagnosis of the current vehicle situation, in both the private and public spheres, and depending on the performance of the electric market in the coming years, the following targets have been established:

- **Municipal fleet**: by means of a gradual regeneration process, have a 100% electric municipal fleet by 2030.
- **Public transport:** assuming the commitment to only acquire zero emission vehicles from 2025 onwards and establishing a renewal period of 15 years, by 2040 the public transport fleet will be 100% electric (approximately 1,200 vehicles).
- **Taxi:** it is envisaged that AMB will stop approving diesel taxis from 2019 onwards and only approve electric taxis from 2024 onwards. Establishing a renewal period of 6-8 years, by 2040, all taxis will be electric.
- **Passenger cars, goods vehicles and motorbikes:** the target set for 2024 is for 4% of passenger cars and 8% of motorbikes to be electric.

The measures to achieve these figures are focused on expanding the loading infrastructure of vehicles, promoting parking benefits, using preferential lanes or recharging and continuing to work on offering subsidies for vehicles that use alternative energy as well as more rebates on road tax.



Urban greenery and biodiversity

Barcelona wants to naturalise the city

Urban greenery and biodiversity

Vision of the future

Naturalising the city and building a functional green infrastructure

Current situation

Urban green spaces

28.35 km² of green surface area

17.45 m² per inhabitant

200,000 urban trees

40,000 in parks and gardens

40 % strictly urban greenery

60 % forest greenery in Parc de Collserola

Biodiversity

10 species of wild orchids conserved

231 species of common bird in the SOCC

83 species of breeding birds

34 species of butterfly inventoried

10 species of amphibians and increase in the population

19 species of reptiles

74 species of protected vertebrae

Lines of action

Increasing the green infrastructure
"Parks, roofs, terraces and public roads"

Naturalising the city
"Eradication of glyphosate"
"Sowing in tree pits"
"Biodiversity structures"

Awareness raising and citizen participation "All hands to greenery"
"School gardens and allotments"
"Making way for greenery" "Citizen Science" "BUITS Plan"

Monitoring and assessment
"Socio-environmental services in green spaces"
"Water-sun relationships"

4.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to naturalise the city and build a functional urban green. This requires the following measures:

- Increase the green space and spread it out to ensure its presence in all corners of public and private spaces to improve residents health and quality of life.
- Naturalise green spaces to promote biodiversity and optimise eco-system services that provide for and are key in the mitigation of and adaptation to climate change
- Include greenery as a structuring element of new urban projects.
- Ensure the permeability of green spaces as a strategy to harness water resources.

The density and consolidation of Barcelona's urban fabric is dependent on actions to promote urban green spaces and biodiversity, whilst promoting the involvement of residents to that end. The main conditioning factors and opportunities are as follows:

- **Barcelona is a compact, dense and consolidated city,** which makes the creation of new parks and gardens to increase the green surface area more difficult. To that end, new spaces, like the superblocks, the city block interiors, empty plots, roofs and green walls must be sought to improve the quality of greenery through naturalisation. Thus, conceiving greenery as an infrastructure made up of a wide variety of elements that interact with public and private spaces is essential, in addition to these spaces being connected to one another and with natural spaces in the surrounding area to create a green network.
- **Barcelona is a Mediterranean city characterised by irregular rainfall and summer heat.** The Mediterranean climate is characterised by limited and irregular rainfall, while long periods of drought and very intense rainfall are commonplace. This aspect limits the water holding capacity of vegetation and it is believed that climate change will only worsen this situation. Therefore, the increase in urban green spaces must be capable of supplying mainly alternative sources of water.
- **Vegetation, a key element in mitigating climate change and adapting to it.** The temperature regulating effect of vegetation will help to mitigate the heat island effect and make the city more resilient to heat waves, while contributing to carbon sequestration.
- **The predicted effects of climate change on biodiversity.** The increase in temperatures and variation in humidity may have important repercussions on ecosystems and diversity, promoting phenological changes in the plant cycle, the appearance of invasive species and the risk of pests appearing. Therefore, work is required on conserving species, particularly those that are sensitive to climate change.
- **We are in the process of changing the city model,** as part of which greenery will be included as an element that gives structure to other urban policies, such as land planning, mobility, public health, sustainability, social rights or culture.

4.2 General context and current situation

Urban green spaces provide environmental services that are essential for the city, such as connectivity, biodiversity, microclimatic and water regulation, carbon sequestration or improving noise and air quality, in addition to affecting social services, such as health, welfare and the relationship opportunities of individuals.

The temperature-regulating effect should also be mentioned. as this translates into energy savings and makes green areas an element in resilience and adapting to the possible effects of climate change, such as more frequent heatwaves and accentuation of the heat island effect.

4.2.1 Planning to conserve and improve the city's ecological infrastructure

To that end, in 2015, Barcelona presented the Barcelona Climate Commitment ⊕, in which the city set the target of increasing greenery by 1.6 km^2 by 2030, in other words by 1 m^2 per inhabitant. The 2020 Greenery and Biodiversity Plan ⊕, published in 2013, established that nature in the city represents an ecological infrastructure and actions were planned to conserve and improve the city's natural heritage, preventing the loss of species and habitats, in order to achieve the maximum green surface area and work on connectivity, through green corridors, to obtain the maximum eco-system services and make the city more resilient to the challenges of the future.

The 2017 Programme for Promoting Urban Green Infrastructures ⊕ spells out part of the Greenery and Biodiversity Plan and also specifies how to achieve those additional 1.6 km^2. Also worthy of particular mention is the 2017 Pla director de l'arbrat ⊕, which sets the target of increasing tree cover by 5% and establishing tree selection criteria based on biodiversity and their suitability for the urban ecosystem and climate. In the same vein, the 2018 Climate Plan ⊕ reasserts the municipal commitments to greenery and also incorporates the following targets: increasing urban green spaces by 1.6 km^2, increasing tree cover by 5% and increasing adapted tree species from 30% to 40%.

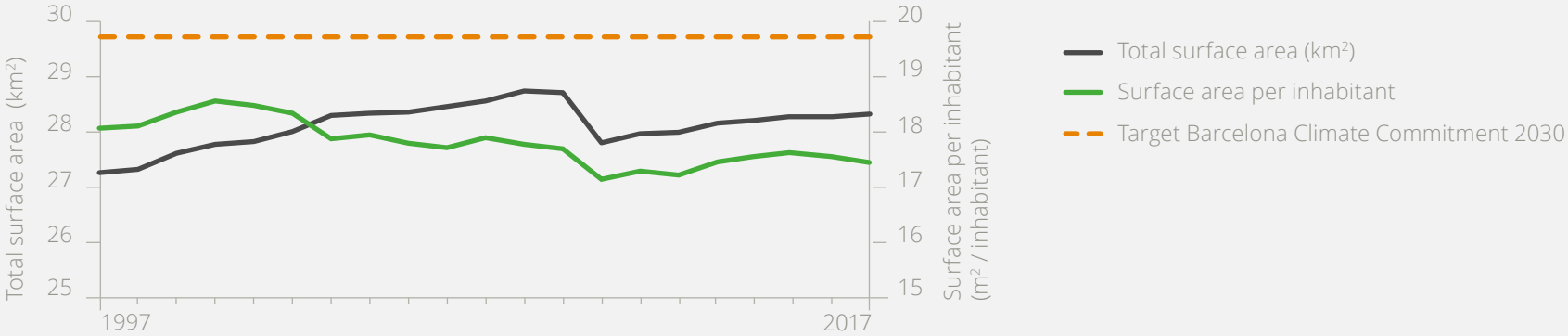
4.2.2 Towards a network of new green spaces

The green surface area in Barcelona comes to 28.35 km^2, of which 11.36 km^2 correspond to strictly urban greenery (40%), and 16,99 km^2 to the municipal area in Collserola Natural Park (60%). This surface area (including urban and forest green spaces) is equivalent to 17.45 m^2 per inhabitant.

The total green surface area has increased slightly each year and has remained stable since 2017. The decrease in 2010 can be attributed to a change in technical criteria in estimating the green forest surface area of Collserola, when it was declared a natural park.

After a period of growth in green surface area per inhabitant, between 2010 and 2014, there was a slight drop in this indicator. The two factors that explain this trend are the stabilisation of green spaces in absolute terms and the growth of Barcelona's population in recent years. Since 2014, this indicator has remained stable. However, the distribution of public green spaces by district is unequal and mainly concentrated in Sants-Montjuïc, Sant Martí and Horta-Guinardó. If we include Collserola, Sarrià-Sant Gervasi is the district where this indicator is highest.

In the city centre, what stand out are the parks and gardens, which account for 70% and represent the basis of the urban ecological infrastructure. Particular mention should be made of Montjuïc (with its cliffs included in the



Generalitat of Catalonia's Inventory of Geological Spaces) and Tres Turons, declared spaces of natural interest, and Parc de la Ciutadella, as an urban green space.

However, the urban green space in Barcelona is modest in size, as 57% of green spaces measure less than 1,500 m², and given their location at the heart of the urban fabric, within reach of residents. Therefore, green walls and roofs, city block interiors, plots, allotments, etc., represent a fundamental part of the city's green infrastructure. Currently, Barcelona has 20 dividing walls transformed into naturalised façades, and, in 2013, the city had 4.3 ha of green roofs. As a result of the green roof competition, it is expected that this figure will increase a further 5,000 m² in 2019.

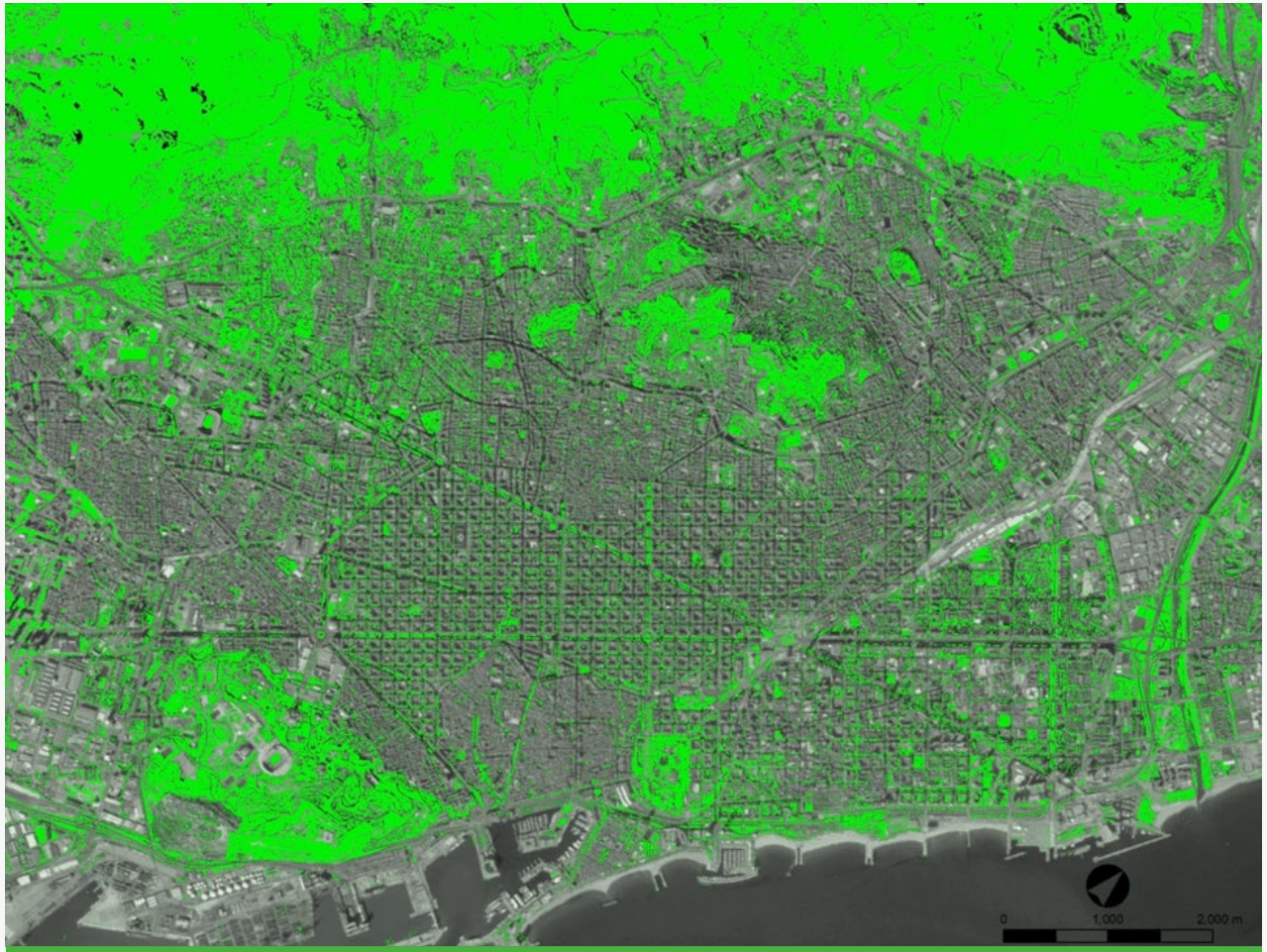
Since 2015, Barcelona City Council has worked on an additional indicator to account for the green infrastructure: the normalised difference vegetation index (NDVI). This indicator, calculated using satellite images or flights with multispectral sensors, makes it possible to monitor the evolution of vegetation in the city on a more widespread basis.

In addition, maps have been drawn up that categorise green spaces depending on their type or function, to assess systems as a whole in terms of connectivity, complementarity of uses, resident accessibility, etc.

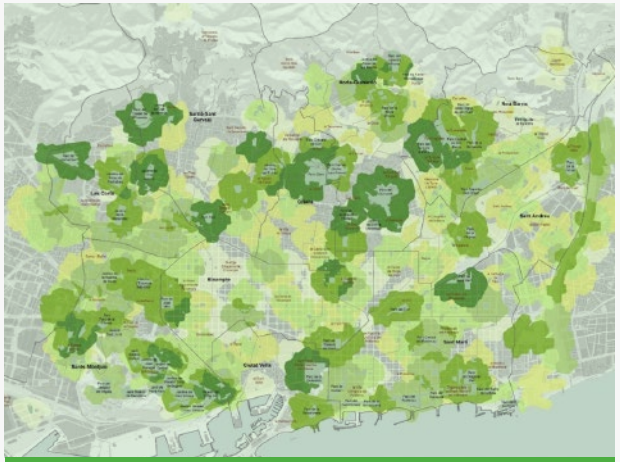
4.2.3 Rich but vulnerable biodiversity

In terms of biodiversity, Barcelona has a wonderful natural heritage thanks to the magnitude of the Collserola range, which frames the city with a mosaic of habitats that play home to a wealth of different species. It is worth mentioning that the 1992 Habitats Directive said that three habitats required conservation (dry meadows, pine woods and holm-oak woods)

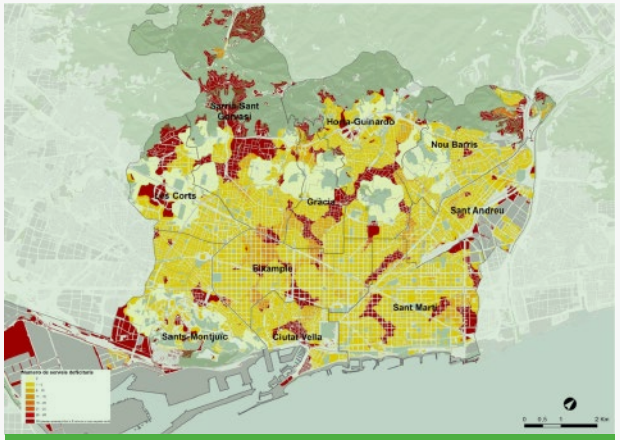
Midway through 2018, the Barcelona Metropolitan Area preliminarily approved the New Special Environmental and Landscape Protection Plan for the Serra de Collse-



The NDVI detects the green cover of all green spaces (private gardens, central reservations, trees lining the streets, etc.) and defines the density and vitality of vegetation.



Accessibility map for the socio-environmental services of green spaces.



Map of shortcomings in socio-environmental services.

rola Natural Park (PEPNat). The new protection model is based on promoting eco-system services and controlling disturbances that have a negative impact on the range's natural systems. Unlike its predecessor, the plan seeks to promote farming activities based on the development of a green economy and defining a new model of public and social use to promote responsible leisure, amongst other factors.

From the Barcelona ecology map (part of an analysis of its evolution since 1977) it can be concluded that woodland and urban green spaces have grown and that crops have been converted into having a merely token presence. There are around 200,000 trees in the urban fabric, apart from those in the city's parks. Among trees and cultivars in the urban fabric and lining the city's streets there are 170 different types. The most common species is the London plane (*Platanus* × *hispanica*), followed by the Mediterranean hackberry (*Celtis australis*), the rosewood (*Tipuana tipu*) and the Japanese pagoda tree (*Styphnolobium japonicum*).

The great potential of aquatic habitats is also worth particular mention. The aquatic flora and fauna of the naturalised lakes in parks and gardens is very rich. In addition, the creation of an urban network of allotments has been a very successful experience, and they have quickly been colonised by field flora and native fauna associated with agricultural spaces.

However, this heritage is constantly under threat from urban pressures. In particular, amphibians are subject to constant disturbances, despite benefiting from careful management. Some plant and animal species in Barcelona have demonstrated invasive behaviour and are capable of compromising habitats, native species or urban heritage, which would entail safety problems and risks to health. In terms of flora, the ailanthus is one of the species that shows the most invasive behaviour. Another phenomenon that poses a threat to plant species is the growing impact of pests: the most significant in recent years are those affecting plane trees (sycamore lace bugs). It must be borne in mind that climate changes may see the arrival of new pests.

The parrot species that have the largest population and repercussion in Barcelona are *Myiopsitta monachus* (originally from South America) and *Psittacula krameri* (originating in Sub-Saharan Africa and India).

As regards fauna, some animals are currently under observation to contain their populations (pigeons, cats, wild boar, parakeet, turtle, fish and billfish), although there is still some way to go in terms of managing species such as the monk parakeet, rose-ringed parakeet, the Japanese nightingale, the Florida turtle or the mosquitofish.

4.3 Measures implemented to set up a functional green infrastructure

In recent years, Barcelona City Council has worked on implementing measures in order to increase urban green spaces to mitigate the impact of climate change and adapt to it, in addition to ensuring there is a green infrastructure that promotes biodiversity and offers maximum ecosystem services to residents.

Stimulus of the urban green infrastructure

To achieve the targets set in terms of urban green spaces and biodiversity, the City Council has defined the Stimulus Programme for the City's Urban Green Infrastructure ⊕, as part of which a range of measures have been proposed between 2017 and 2030 structured around four strategic lines, three lines of direct action and one instrumental line:

- → Increasing the city's urban green infrastructure
- → Improving the existing green infrastructure.
- → Joint responsibility in caring for urban nature.
- → Studying, planning and monitoring the green infrastructure

4.3.1 Increase in the city's green infrastructure

Creation of new green zones

- → **"Urban Canopy" (Plaça de les Glòries Catalanes).** Work has resumed to convert Plaça de les Glòries Catalanes into an area that includes a green space of around 12 ha with leisure uses and incorporates the Rec Comtal.
- → **Doctor Pla i Armengol Gardens (Mas Ravetllat).** As a result of the joint efforts of the Horta-Guinardó District Council and local residents, a project has been approved to arrange and improve the gardens on the Ravetllat-Pla estate in order to convert them into a green block measuring 3.6 ha open to the residents. This initiative seeks to harness the potential of these gardens to highlight the space as a green corridor.
- → **New green hub in Cristóbal de Moura.** The redevelopment of this street will convert it into a green, traffic-calmed space with a landscaped central platform and a wooded area 26 m wide. In total, this will create 3,500 m² of green space.
- → **Transformation of Avinguda Meridiana.** The aim of this renovation work is to convert the avenue into a green promenade that prioritises pedestrians, cyclists and public transport and serves as a meeting space. It will add 58,000 m² of green space to the city.

Living roof terraces and green roofs

In 2015, Barcelona City Council published the Guide to Living Roof Terraces and Green Roofs ⊕, which seeks to serve as an instrument for promoting a reassessment of the roofs on city buildings and the use of these spaces by residents.

Green roof competition

Green roofs can include green spaces, urban allotments,

The ten selected projects will receive a subsidy of 75% of the cost of the works and the technical studies required, up to a limit of €100,000.

The 14 active spaces can be consulted on the BUITS Plan website.

spaces for social use or rainwater harvesting systems, and they are compatible with the installation of renewable energy sources. In 2014, the City Council approved a government measure to promote living terraces and green roofs. Later, in 2015, around the project and working group on mosaic roofs that came out of the Barcelona Climate Commitment, Barcelona organised a call for tender ⊕ to subsidise the creation of ten green roofs on residential buildings, teaching facilities, health facilities or buildings with other uses. All these projects have a strong environmental, social and landscaping impact.

Assigning spaces in disuse under the BUITS Plan

The first call for the BUITS Plan ⊕ (Urban Voids with Territorial and Social Involvement) was organised in 2012. By means of this plan, the City Council allocates temporary use of municipal land sites in disuse to public non-profit entities or associations so they can carry out activities there. In 2015, the six successful projects put forward greenery-related proposals and of the 12 active locations from the first call, nine involve uses relating to urban farming.

ECOsolars programme

As part of the ECOsolars programme, empty plots are identified, classified and defined as spaces of opportunity capable of being restored, in some cases, as future green spaces. Urban plots with renaturalisation potential are identified, in other words, to promote biodiversity and recover existing native urban flora or strengthen flora by planting grass.

Green dividing walls and producers of energy

The Dividing Walls Plan provides for the installation of vertical gardens and the harnessing of renewable energy on the city's dividing walls. Its objectives include renaturalisation and the promotion of biodiversity through non-colonising vegetable treatments and the creation of nests and spaces for protected birds.

Among the interventions performed, one worth particular mention is the Tarradellas vertical wall, comprising 250 m^2 of greenery on a dividing wall on the corner of Carrer de Berlín and Carrer del Marquès de Sentmenat, and the diving walls planned for Plaça de les Dones del 36 and the Muñoz Ramonet gardens.

4.3.2 Naturalisation of the city

Barcelona is committed to the naturalisation of its green spaces, in other words, converting them into habitats that promote natural processes and the natural entry of flora and fauna through ecological management, with a view to achieving a more complex vegetable structure and optimising ecosystem services.

In 2016, a project involving 22 naturalisation actions in green spaces spread across the entire city was launched. Other naturalisation actions have been taken, including the following:

Eradication of glyphosate and reduction in phytosanitary treatments

As part of the 2016 government measure to eradicate the use of glyphosate in green spaces and public roads in Barcelona, in 2017 no chemical herbicide was used in the management of natural plants and tests have been done with different alternative techniques. Based on this experience, the city has been mapped by type of space and the most suitable techniques.

Sowing in tree pits

The Municipal Institute for Parks and Gardens has launched a pilot test, as part of which flowering herbaceous plant have been planted in tree pits and this has been combined with the release of beneficial insects to control the pests and diseases that affect the trees, with a view to decreasing the use of phytosanitary products and converting them into a habitat for fauna. It is planned to continue this experience on account of the interesting results obtained.

In all, more than 1,500 tree pits have been planted, 822 in 2017 and 737 in 2018.

Naturalisation of ponds

Of the more than 300 decorative fountains dotted around the city, some 40 have been naturalised. Thanks to actions to both manage ponds and lakes themselves and the surrounding area, these aquatic spaces have become rich, complex ecosystems.

Areas of special interest for biodiversity

The Parc de Joan Miró and Jardins de Valent Petit have been declared areas of special interest on account of their biodiversity. These spaces are beneficial to fauna (birds, butterflies and other animals), through a selection of plant species that offer feeding options and the creation of refuges.

Changes in tree-pruning and lined tree management

The 2017-2037 Tree Master Plan for Barcelona ⊕ defines 50 actions to achieve its objectives, of which 31 have been launched. Of these, it is worth highlighting the planting of flowering and fruit trees that are of interest to fauna, a more careful approach to pruning with regard to flowering, fruiting and the fauna cycle, and the diversification of species.

More sustainable decorative flora

Planting flower groups that combine perennial plants, shrubs and bushes promotes biodiversity and makes a more ecological approach to management possible, as these plants have a much longer duration than traditional seasonal flower groups. Around 7,000 m^2 of new groups of ornamental flowers have been planted in flowerbeds and flower boxes.

Installation of new biodiversity structures

More than 80 new fauna structures (insect hotels, dry stone spirals with aromatic plans, piles of wood, nest

Example of an insect hotel.

boxes for bats, nests for hedgehogs, etc.) and 392 birds' nests have been set up to provide refuge, food and facilitate the reproduction of urban fauna.

Guide *Best gardening practices in Barcelona*

In 2016, the Urban Ecology Department published *Best Gardening Practices in Barcelona: conserving and improving biodiversity* ⊕. This initiative is intended to serve as a technical instrument to spread the best practices that help to improve the condition of green spaces and thus collaborate in the development of flora and fauna.

4.3.3 "All hands to greenery" with residents

Shared responsibility with city residents in caring for and extending greenery is essential. Their action, in both public and private spheres, has been a significant contribution.

"All hands to greenery"

The aim of the "All hands to greenery" project is to activate green plots in the city on Council-owned land not in use. The project is intended to generate an opportunity for residents to temporarily find a new use for the empty plots across the city and to involve social players in their regeneration and revitalisation.

One of the project's lines of action consists in offering municipal plots that have fallen into disuse to non-profit organisations so they can create a community allotment or garden they manage themselves and to promote activities related to greenery and caring for nature. To that end, a study has been carried out on vacant public plots in the consolidated urban fabric across the city where there are no plans to build anything or give them a permanent use in the short term.

Community allotments

In 1997, Barcelona set up the Network of Urban Allotments, targeting retirees, with different functions and involving different entities. Currently, there are 15 allotment sites ⊕ spread around all the city's districts.

School allotments

As part of the "More Sustainable Schools" programme, in which schools develop their sustainability plans, around 300 schools ⊕ have allotments with learning spaces.

Vertical gardens in schools

Thanks to the agreement between the City Council's Green Spaces and Biodiversity Department and "la Caixa" Welfare Projects, 14 schools now have vertical gardens. The "More Sustainable Schools" programme offers training and advice to construct these spaces.

Participation and dissemination activities

Various activities and events are organised in the city to draw the public closer to green spaces and biodiversity:

- **"Music in the parks".** Every year the city's green spaces fill with music thanks to "Music in the Parks". Since 2016, this has included guided tours to raise public awareness of the environmental and heritage values of the parks.

- **Environmental facilities.** Fàbrica del Sol ⊕ organises tours to discover the most unique aspects of parks and gardens with "The art of visiting a garden", and to see how the seasons affect different green spaces, with "Seasonal sensations". Sustainable gardening and ecological horticulture workshops ("Planting nature") are also organised for everyone, with the aim of increasing greenery in the home.

- **"Let's make way for greenery".** This advertising campaign seeks to raise public awareness and inform people of activities to increase the amount of greenery and naturalisation of green spaces that are being carried out in Barcelona. This campaign includes new signs to identify the activities.

4.3.4 Promoting a new zoo model in Barcelona

2018-2031 Strategic Zoo Plan

As a result of a participatory process, a new zoo model has been drawn up, along with the Strategic Plan that lays the foundations for Barcelona Zoo become a global benchmark and, at the same time, a meeting point for research, conservation and the promotion of native, Iberian and Mediterranean fauna. The new zoo model proposed is the result of the commitment to animal welfare at the heart of all activities carried out. The conservation criteria defined entail the restructuring of the number of species currently housed to prioritise native fauna, those that are highly endangered in nature and those for which conservation plans are in place. The scientific approach will entail investing more in research and habitat conservation projects, in addition to stepping up educational aspects. This transformation will go hand in hand with the renovation of physical spaces. There will be a new layout, with new spaces and improvements to the other facilities.

The purpose of the project is for Barcelona Zoo to become a meeting point for research, conservation and the promotion of native, Iberian and Mediterranean fauna.

4.3.5 Monitoring and assessing greenery and biodiversity

"Green corridors" project

Since 2006, Barcelona has been working to promote a network of green corridors that connect the natural spaces of Collserola and the coast with green spaces in the urban fabric, facilitating the movement of species and the promotion of environmental services. The first green corridor is currently being rolled out, between Ciutadella and Collserola.

The intervention on Carrer de Pi i Margall, as part of the green corridor, provides an opportunity to extend the Parc de la Ciutadella – Serra de Collserola Natural Park axis. An executive project is currently being drawn up for Carrer de Pi i Margall.

Study of socio-environmental services in Barcelona's green spaces

Barcelona City Council and Barcelona Regional have drawn up a study to define the ecosystem or socio-environmental services that provide residents with access to green spaces, which will help to design spaces in a way that optimises their use. The study encompassed 326 green spaces, including parks, gardens, historical gardens, city block interiors and some squares (those with a plant cover of more than 30% and 40% permeable soil).

Study of water-soil relationships

In 2013, a study was produced on water-soil relationships in the main landscaped areas of the city in order to identify the characteristics of the soils and water used to irrigate gardens. Based on the results obtained, recommendations have been made on aspects linked to improving the soil, irrigation and water management.

For example, the Sustainable Urban Drainage Systems (SUDS) Committee was set up in 2016, with a Barcelona City Council technical team, to define the parameters for contributing to the strategy for harnessing water resources in the city. The study included the compilation of SUDS experiences across Barcelona.

Improving tree soil and new developments

In 2016, a diagnosis was carried out on the soil improvement techniques used in designing and maintaining green areas and lined trees, establishing the most suitable techniques in each case, in order to preserve, identify and recover fertile, living and functional soils compatible with the planned uses and maintenance.

Study on invasive species in Barcelona and a proposal for alternative species

Gardening is one of the main ways in which invasive plants are introduced into the natural environment, so Barcelona City Council decided it was necessary to implement two lines of action: (i) the identification of invasive species and the proposed use of alternative species with prevention in mind, and (ii) the management and potential eradication of invasive species. As a result of the former, this study was published in 2014.

Barcelona Breeding Bird Atlas

There are 83 species of birds living in Barcelona,according to the *Barcelona Breeding Bird Atlas*. The Atlas, created in collaboration with the Catalan Institute of Ornithology, the University of Barcelona and Barcelona Zoo, stands out for its detailed fieldwork.

The common phylum (*Pittosporum tobira*) is an invasive plant that is cultivated in gardening due to its large ductility.

4.4 Future goals and measures

In order to increase the green surface area in the city and naturalise green spaces to promote biodiversity and optimise the ecosystem services that they provide, a key factor in mitigating and adapting to climate change, Barcelona City Council has a variety of strategic plans in place.

2017-2037 Tree Master Plan

This Plan, approved in 2017, is the strategic document that guides municipal action in planning, managing and conserving all the trees in the city. It features 50 actions divided into 10 strategic lines to achieve the targets set out for 2037:

- Increase the city's tree cover by 5%, ensuring that 30% of the city's surface area is covered by trees.
- Ensure 40% of tree species are adapted to climate change.
- Achieve a biodiverse tree heritage in which no single tree species accounts for more than 15% of the total population.
- Provide the general public with all the information on the characteristics of each tree and the services it provides.
- Ensure that the children in all Barcelona's primary schools appreciate and can identify the trees in their neighbourhood.

2017-2030 Programme to Promote the City's Urban Green Infrastructure

This measure forms part of the 2020 Greenery and Biodiversity Plan, which establishes the objective of achieving a green infrastructure that offers maximum ecosystem services. It proposes measures to intensify the generation and naturalisation of green spaces and specifically defines the spaces where this will take place up to 2019.

Parc de la Ciutadella.

MAIN MEASURES OF THE PROGRAMME TO PROMOTE THE CITY'S URBAN GREEN INFRASTRUCTURE

Increased greenery

The six actions established in the first strategic line (creating green spaces, recovering city block interiors, temporarily landscaping of empty plots, interventions in public places, and greening roofs, walls and dividing walls) will enable the green surface area to be increased by 44 ha between 2015 and 2019, and achieve 165 ha between 2015 and 2030.

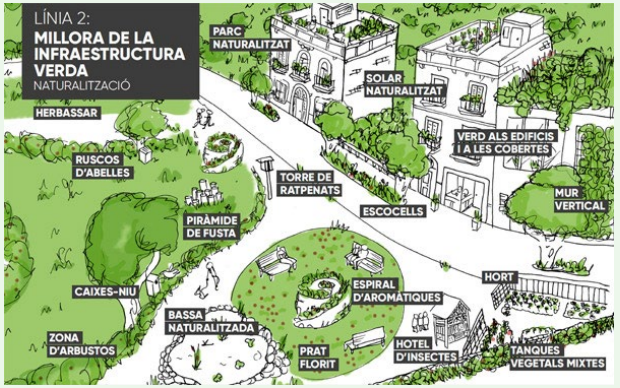
Increased greenery (m²)	2015-2016	2017-2019	2020-2030
Action 1.1. Creation of green spaces	74.602,24	138.710	833.238
Action 1.2. Recovery of city block interiors	11.816,41	38.237,11	8.800
Action 1.3. Temporary landscaping of vacant plots	15.946	16.754,16	30.800
Action 1.4. Interventions in public places	32.760,46	106.060,46	304.700
Action 1.5. Greening roofs	-	5.431	22.000
Action 1.6. Greening walls and dividing walls	606,3	3.232	12.100
TOTAL	**13,57 ha**	**30,84 ha**	**121,16 ha**
Total new green surface area	**13,57 ha**	**44,41 ha**	**165,57 ha**

Increasing the biomass of green spaces

The city's green spaces, in particular its parks and gardens, and spaces such as Plaça dels Països Catalans, Plaça Joan Peiró and Moll de la Fusta, have the potential to increase the density of plant life. To do so, plant species will be selected that, a priori, are less vulnerable to climate change, and trees and bushes will be diversified in terms of species, appearance and height, in order to achieve vertical and horizontal continuity.

Conservation of natural spaces

Barcelona has three natural spaces of special interest with regard to biodiversity: the Montjuïc cliffs, Rec Comtal and Tres Turons. These three areas are dry grasslands, which are particularly interesting habitats in terms of the biodiversity of flora and fauna. To preserve these open spaces, their closure due to the sudden or manufactured growth of woody species must be prevented.



Promoting green corridors

The final push to the green corridor for the Parc de la Ciutadella-Serra de Collserola Natural Park axis is gradually taking shape in the new Carrer de Pi i Margall development.

Harnessing water resources

The city has alternative water resources (fountains, wells, groundwater, Rec Comtal, etc.) that are used for irrigation and other public uses. As the priority for these resources is to increase the urban greenery, their quality must be preserved and their sustainability in quantitative terms must be guaranteed. For that reason, the Alternative Water Resources Plan for has been updated *(see Section 9.3.2, "Harnessing alternative water resources")*.

Civic co-responsibility for taking care of urban nature

There are currently public and private space in the city that are in a temporary state of abandonment or lack of management. As a solution, the City Council wants to explore the urban custody system by transferring municipal spaces to social and community organisations so they can occupy them.

A regards the private sphere, the Council intends to promote landscaping terraces, balconies, roofs and interior patios, installing green roofs and walls in new buildings and creating private allotments, by providing grants, advice and follow-up.

New greenery model for the city

One of the actions included in this measure is to plan Barcelona's green infrastructure as a system, which includes the green corridor network and is in line with the socio-environmental services. To that end, work is under way to create a new greenery model for the city and being coordinated with a review of the Urban Development Master Plan (PDU).

Sustainable land use

Barcelona, urban planning for the neighbourhoods

Sustainable land use

Vision of the future

To become a city with urban planning for the neighbour-hoods

Current situation

102.2 km² **Surface area**

1,620,809 inhabitants

158.7 inhabitants per ha

63,8 % of the population of Catalonia resides in the Barcelona Metropolitan Area

Planning instruments

General Metropolitan Plan for Barcelona (PGM) **1976**

Territorial Metropolitan Plan for Barcelona (PTMB) **2010**

Urban Development Master Plan (PDU) –in progress- **2013**

Land uses (2016)

Residential 25 %

Facilities 11 %

Urban parks 13 %

Industry and infras-tructures 13 %

Road network 22 %

Forest parks 16 %

Lines of action

Strategic projects "Superblocks" "Glòries" "La Sagrera" "Avinguda Meridiana" "The Model prison" "The waterfront"

Social urban planning "Urban planning with a gender perspective" "Neighbourhood Plan"

Public works with a smaller environmental impact "Making municipal works greener" "Sustainable urban planning workshops"

Planning "Urban Development Master Plan"

5.1 Vision, challenges and opportunities

Vision of the future

Barcelona's goal is to become a city with urban planning for neighbourhoods, where the built city becomes a large metropolitan area with territorial cohesion and environmental sustainability.

Over the course of history, the city has adapted to the way in which people live. Now it is facing new challenges on account of the new needs of its residents.

→ **Barcelona is a dense, compact city,** with all the benefits that brings with regard to travel needs and energy consumption. However, at the same time, there are clear shortcomings that need to be corrected urgently: the level of air pollution, the lack of greenery, the noise generated by traffic, road accidents, the quality of meeting places and so on.

→ **This model favours the development of everyday life but it does not necessarily incorporate a gender perspective.** Urban planning with a gender perspective and which is based on an inclusive model puts everyday life at the centre of its policies and adopts an inclusive approach to respond to the needs of society as a whole, taking into account its gender, age, origin and functional diversity, among other things. The result is a fairer, more equitable and safer city without barriers.

→ **The compactness and different uses promote urban vitality on the city's streets.** Streets must be main setting in which children can play and neighbours can come together, as well as for leisure, relaxation, economic exchanges, sport, culture and demonstrations. However, in recent decades, their role as a place for meeting and leisure has declined appreciably, if these activities have not disappeared from the city's streets altogether, giving way almost exclusively to a traffic function.

→ **Barcelona wants to increase its green spaces and guarantee an equal distribution** but, as it is a dense and compact city, this is increasingly more difficult, due to the lack of space. New spaces therefore need to be found, such as superblocks, to convert streets into green spaces and improve the quality of greenery through their naturalisation. So it is vital that urban planning and development in the city incorporates more greenery as one of its objectives.

→ **There is limited space with permeable soil.** The urbanisation process, entailing the construction of buildings and roads, while restricting the space available for urban greenery, has resulted in the land becoming less permeable, meaning alternative solutions are required to retain rainwater.

→ **A tourist and stop-off city.** Barcelona's strategic location, and the fact that it has one of the main airports and ports on the Mediterranean coast, together with the high level of economic activity, have made is a stop-off city with a high level of traffic. Furthermore, it is one of Europe's main tourist destinations and this has heightened pressure on services in the city.

→ **Barcelona is immersed in a housing emergency.** To guarantee the right to housing, a housing policy must be implemented that addresses the current situation and responds to the specific causes that compromise access to housing in the city. Furthermore, progress is needed in building a public housing service.

5.2 General context and current situation

Barcelona is one of the most densely populated cities in Europe. In 2016, 36% of its surface area was occupied by residential areas and facilities. Green urban areas represented 29% of the municipal area, the road network accounted for 22%, while industry and infrastructure occupied 13% of the city.

Urban development in Barcelona is based on redistributive planning that defines the city's neighbourhoods as the structural pillar of the territorial system and encourages the creation of a neighbourhood metropolis. That requires decisive action to avoid territorial divides, ensure the same opportunities in all neighbourhoods and create an indispensable local space for social involvement and the generation of environments that promote public health and well-being. In that context, defence of and a commitment to a city's most-prized asset, public space, becomes a key goal.

Barcelona, a city undergoing constant transformation and evolution, has instruments and mechanisms to enable harmonious and rational planning of its territory and uses, with a view to ensuring development in line with the needs of its residents.

Urban planning involves an urban plan and, as a framework, Barcelona has the General Metropolitan Plan ⊕ (PGM), approved in 1976 and still in force, plus the occasional amendments in the areas which, over the course of time, have needed a new approach. A review of the PGM is currently under way based on the provisions of the Metropolitan Urban Development Master Plan ⊕ (PDU), which entails a general change in the way in that urban development in Barcelona is regulated and which will be reflected in the subsequent drafting of the Municipal Urban Development Plan (POUM).

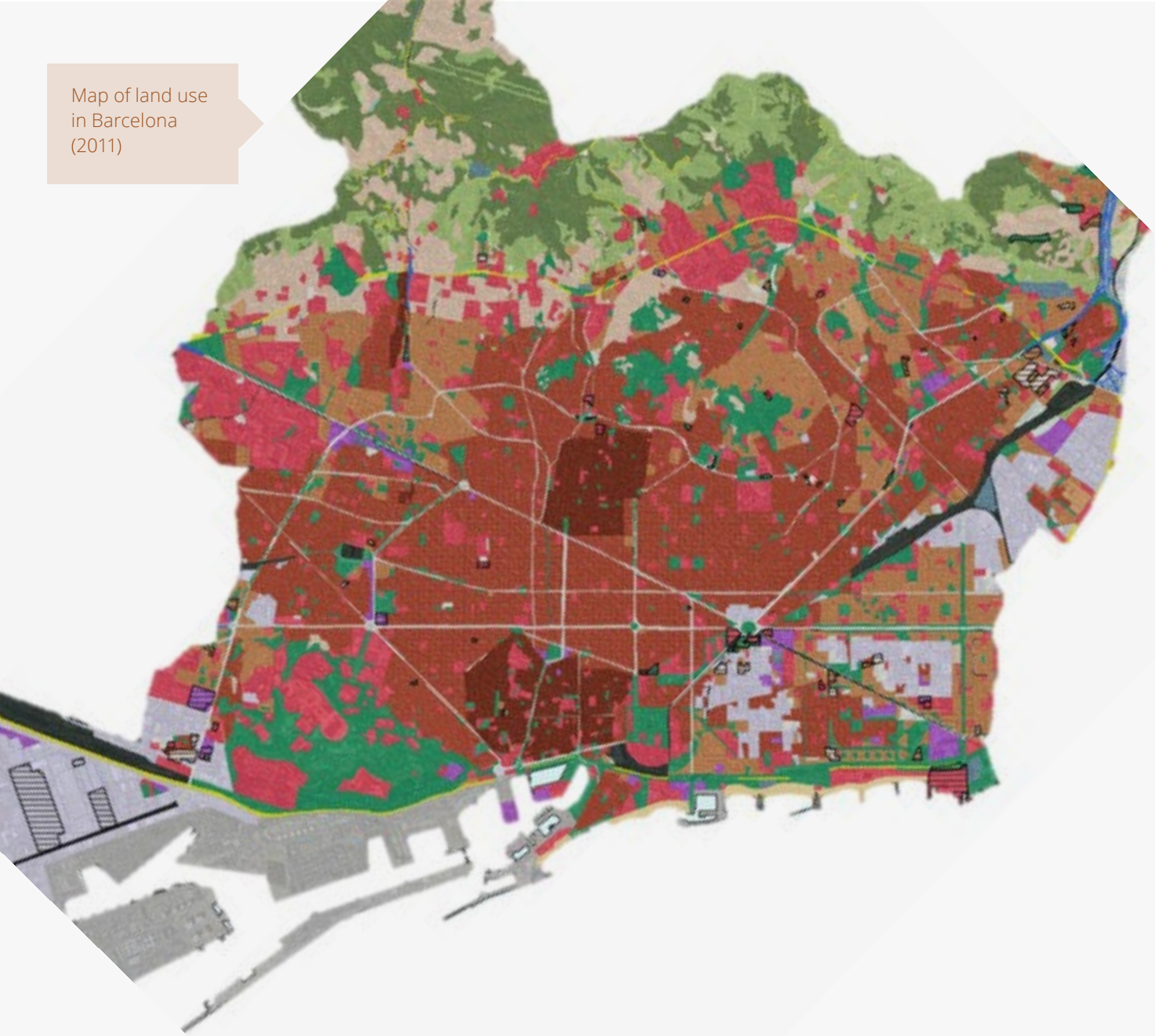
On urban land, the general urban development plan is implemented through derived plans, including urban improvement plans and special urban development plans.

In 2010, the Catalan government approved the Metropolitan Urban Development Plan for Barcelona ⊕ (PTMB). This is a planning instrument that seeks to facilitate regional planning in the area comprising the Alt Penedès, Baix Llobregat, Barcelonès, Garraf, Maresme, Vallès Occidental and Vallès Oriental counties, which covers 3.236 km^2 and includes 164 municipalities. The purpose of this is to define the metropolitan region of Barcelona as an environmentally sustainable, economically efficient and socially fair reality, as established in Act 31/2010, of 3 August, on the Barcelona Metropolitan Area.

Barcelona has various bodies through which it can use its powers to implement the city model. The offices of the Urban Model Director and the Deputy Manager for Urban Development work on the built fabric, the urban fabric, the green network, facilities and public spaces, carry out strategic projects and oversee heritage conservation, as well as compliance with urban development regulations, which are drawn up by the Ecology, Urban Development and Mobility Area. It is worth noting the main advantage of this area is that it brings together most of the public players with an impact on the city. Thus, for the first time, there is an overall vision of urban development, the environment and mobility.

The main bodies and companies involved are the Municipal Institute of Urban Landscape and Quality of Life (IMPUQV), which is responsible for planning and rationalising public space and the urban landscape; the Municipal Institute of Urban Development (IMU), which serves as a point of reference in neighbourhood transformation and regeneration processes, as well as in the management of urban development; and Barcelona d'Infraestructures Municipals, SA (BIMSA), which is responsible for infrastructure development and service provision, including building.

Map of land use in Barcelona (2011)



1. Residential
- Old quarter
- Building in enclosed block
- Isolated multi-family building
- Terraced housing
- Single-family building
- Homogeneous residential

2. Industrial
- Industrial

3. Tertiary
- Offices or commerce

4. Parks
- Park or garden

5. Facilities
- Facility

6. Infraestructure
- Port
- Airport
- Railway
- Motorway or dual carriageway
- National highway
- Regional highway
- Main urban road
- Interstitial street space
- Technical service

7. Agriculture
- Agriculture
- Rural industry
- Greenhouse

8. Natural spaces
- Forest or wooded area
- Bushes
- Grassland
- Other vegetation
- River, lake or pond
- Beach
- Bare soil

5.3 Measures implemented to improve urban quality

With a view to progressing towards a new city model structured around residents, in recent years, urban development has been a tool for increasing the greenery in the city, promoting sustainable mobility and recovering public spaces for people.

5.3.1 Urban planning instruments

Urban Development Master Plan (PDU)

At the end of 2013, the Barcelona Metropolitan Area started the process of drawing up a Metropolitan Urban Development Master Plan ⊕ (PDU) that is due to be completed between 2021 and 2023. Its preparation is structured around three pillars: debate and technical reflection, promoted by thematic workshops with groups of specialists; the constitution of the plan's drafting team; and communication and participation, essential elements that must make it possible to enrich the plan with the concerns and desires of institutions, groups and residents. Unlike the PGM-76, the new plan is more focussed on transformation more than urban development, as there is now a limited amount of land pending planning and occupation. It is an opportunity to rethink the existing city, making it more sustainable, competitive and healthy to the benefit of the environment and the quality of life of its residents.

Subsequently, on a city level, the PDU will give shape to a municipal urban development plan (POUM).

5.3.2 Urban transformation to a city for people

2016 -2019 Comprehensive Public Space Rehabilitation Plan

In 2016, Barcelona City Council approved the Comprehensive Public Space Rehabilitation Plan, which sets out comprehensive reactions in 140 spaces and roads to the end of 2019, with an investment of €115 million.

During the Plan's first two years, 93% of the actions envisaged have been carried out or started. As a result of these actions, a total of 7,450 m^2 greenery has been obtained, 883 trees have been planted, 65,513 m^2 of streets have been renovated, 1,985 new lights and 1,163 benches and seats have been installed, and 16 new children's play areas created.

The superblock model: recovering public spaces for people

Barcelona faces significant challenges in terms of air pollution, traffic congestion and the need for more green spaces. These urban challenges require bold pacification solutions to make the city a place for living in. This is the backdrop to the "Let's fill the streets with life. Establishing superblocks in Barcelona" programme, a tool for reorganising the city based on a new kind of mobility and improving environmental conditions, gaining quality public space for people and enhancing the social functions of interaction, leisure and health.

The model of organising public space in superblocks seeks to diversify the characteristics of habitability, mobility and biodiversity in Barcelona's streets to reclaim a public space in environmental conditions suited to the lives of people who live in the city. The superblocks ⊕ programme seeks primarily to set up a network of streets in which residents take priority in terms of mobility and the use of public space, limiting motorised transportation and promoting a shared, green and safe space.

In 2018, Poblenou's superblock received a special mention in the European Prize for Urban Public Space.

→ **El Poblenou.** The Poblenou superblock was implemented in September 2016. Two years later, it has reclaimed 25,000 m² of new space for local residents, increased the green spaces (from 9,722 m² in 2016 to 18,632 m² in 2018) and provided play areas (2,483 m²).

→ **Sant Antoni.** As a result of the first phase of implementing the superblock programme in Sant Antoni, the area round the new market has a large square measuring 1,800 m² which, along with the intersection, streets and squares around the market, make up a total 5,000 m² of public space for residents to enjoy. In the second phase, planned from October 2018 to May 2019, more than 21,000 m² will be reclaimed.

→ **La Maternitat i Sant Ramon.** Creating the superblock in Les Corts, which was completed at the end of 2018, involved redeveloping and pacifying 6,000 m² on three streets: C/ Conxita Supervia, C/ Regent Mendieta and C/ Benavent.

→ **Horta.** Rolling out the superblock in Horta's old quarter will recover 2,832 m² and include the pacification of four streets: C/ Fulton, C/ Horta, C/ Feliu i Codina and C/ Chapí. Street furniture will also be replaced and there will be more greenery with the addition of new flower boxes. Work is already under way and it is expected to finish in July 2019.

→ **Hostafrancs**. This includes the pacification of C/ Consell de Cent, with just one lane for motor vehicles and a dual bicycle lane. It also includes pacifying C/ Torre d'en Damians and C/ Rector Triadó, between C/ Consell de Cent and C/ Creu Coberta, to give priority to pedestrians.

New green hub in C/ Cristóbal de Moura

The reurbanisation of C/ Cristóbal de Moura seeks to transform this street into a traffic-calmed green space with less traffic, a healthier space with areas that encourage neighbourhood activities linking Parc Central del Poblenou and Parc del Besòs. In addition to the central reservation, 26 m wide, landscaped and lined with trees, there will be 3.5 m pavements, a bike lane and a service lane.

Transformation of Les Glòries

The transformation of Les Glòries ⊕ seeks to convert the current space into one for people. Following demolition of the flyover, the road works are currently focused on building the tunnels to pacify traffic and promote sustainable mobility.

The complexity of the project and the limitations on the infrastructure work mean that it has to be carried out in stages and different areas. The first of these stages corresponds to the Gran Clariana park. This area occupies around a quarter of the total surface area. The following stages correspond to the central area, including the tunnels, which cannot be completed until 2021; the coastal side, which depends on work to link up the tramlines; and the mountain side, which depends on progress with the Special Plan.

The design for remodelling of this space was the subject of an international call for tenders and the winning bid (Canòpia Urbana) provides for the construction of a central park spanning 9.5 ha with refuges for fauna, a new avenue for pedestrians and cyclists, infant play areas, a leisure-sports space for young people and an area for dogs, as well as public housing and educational and cultural facilities.

Les Glòries

La Sagrera, rail and urban transformation

Work on the La Sagrera station ⊕ resumed at the start of 2018. This will cover 38 ha of railway tracks for a large central park of over 40 ha. The plans also include building more than 10,300 flats, 40% of them protected (social) flats, along with offices, shops, hotels and various facilities around the new station.

The project places a lot of emphasis on vegetation, with more than 10,000 trees to be planted, combined with shrubs, grass and low absorption paving.

Avinguda Meridiana, a new traffic-calmed green artery

Avinguda Meridiana currently acts as an urban motorway which around 100,000 vehicles and 10,000 pedestrians use every day. Consequently, the City Council and local residents want to remodel it between Plaça de les Glòries Catalanes and the Nus de la Trinitat junction, to create a new traffic-calmed, green promenade prioritising pedestrians and sustainable modes of transport.

This transformation has involved the urban planning of everyday life. A technical, participatory study has been carried out with the intention of getting the neighbourhood view and that has spotted roads that need to be developed as roads that link the neighbourhoods around the avenue in an effort to overcome the barrier it currently represents. These intersections generate

hubs, spaces where pedestrian crossings are prioritised and which, at the same time, are spaces that identify the neighbourhoods and serve as a strategy for pacifying traffic. The work, which began in 2018 and is expected to end in March 2019, will provide 58,000 m^2 of green space, new bike lanes and leisure spots.

Improvements to Via Laietana

Work has begun on improving the space for pedestrians and walking between the Gothic quarter and the Sant Pere, Santa Caterina i Ribera neighbourhood. It is part of the overall process of remodelling Via Laietana to make it more friendly, with more public space for pedestrians and more sustainable mobility. To that end, a participatory process involving local people, traders and associations is already under way.

Pacification of Carrer Gran de Sant Andreu

The renovation of Carrer Gran de Sant Andreu will prioritise the space for pedestrians, with a central strip at least 3.5 metres wide on the same level as and connected with the pavements and adjacent streets to facilitate accessibility. The shopping hub will retain the existing lined trees and plant life will be enhanced with more shrubs and flowerbeds. Spaces with new street furniture will also be created for pedestrians to sit and the paving will be also be renewed, as will the telecommunications cables and drainage pipes. In addition, speed limits will be applied to bicycles, service vehicles, cars, motorbikes and scooters.

The first phase, between Passeig de Fabra i Puig and Carrer de Sant Adrià, was completed in 2018 and the second, between Carrer de Sant Adrià and Carrer de Joan Torras, will continue until May 2019. The budget for this work is €4.9 million.

Remodelling Carrer de Pere IV

The transformation of Carrer de Pere IV into a pleasant, traffic-calmed street that prioritises pedestrians is now into its second phase, which encompasses the section running from Rambla de Prim to Carrer de Josep Pla. The transformation, as was the case between Carrer de Bilbao and Carrer del Roc Boronat, will do away with the current three lanes and introduce a new one-way system with a traffic lane and a service lane. On the mountain side, there will be a separate two-way bike lane.

These actions seek to recover space for pedestrians, with wider, more pleasant pavements (approximately 15 m on the mountain side and 5.45 m on the sea side), the planting of lime trees, the installation of lighting and new street furniture and the adaptation of pedestrian crossings and traffic lights.

5.3.3 Barcelona's commitment to social urban development

Urban planning with a gender perspective

The government measure on urban planning with a gender perspective includes a package of measures for integrating a gender perspective into all urban planning policies to achieve a fairer, more equal, safer city without barriers:

- Integrating a gender perspective in the city's major transformation projects, such as Avinguda Meridiana, the superblocks, the New Bus Network and the Neighbourhood Plan.
- Drawing up a map of the city based on exploratory walks as an element of diagnosis.
- Pilot project in the Gràcia district to draw up an everyday network map featuring facilities, services and accessible, safe routes.
- Pilot project to boost the Bon Pastor i Torrent de Estadella Industrial Estate with gender, mobility, safety and employment policies.

→ Review, with a gender perspective, of the provision and location of urban elements that comprise the furniture in the public space.

→ Producing a school mobility plan with a gender perspective.

→ Producing a gender criteria manual for technicians who compile and/or supervise planning figures and projects for the public space.

In addition, the *Urban Planning Manual for Everyday Life* ⊕ was recently published to provide planning criteria and diagnostics tools, from a gender perspective, for the technical staff responsible for urban planning and the staff who prepare public space and facility projects.

Neighbourhood Plan: without neighbourhoods there is no Barcelona

This programme ⊕, rolled out in 2016, seeks to reverse the inequalities between the city's neighbourhoods by means of a series of actions in the social, educational, economic and urban spheres, with a clear cross-cutting and transformative vision, and in collaboration neighbourhood residents. As regards urban planning, the actions are aimed at overcoming shortcomings, poor quality housing and the lack of infrastructures. There are currently ten plans in place spanning a total of 16 neighbourhoods.

Assigning spaces in disuse under the BUITS Plan

In 2012, the City Council launched the Urban Voids with Territorial and Social Involvement Plan (BUITS Plan ⊕) with a view to reviving plots of land in the city that had fallen into disuse by means of temporary activities of public interest run by public or private non-profit organisations, thus encouraging civil society involvement in regenerating and reviving the urban fabric. The activities carried out and the uses are put to are of public interest or have a social purpose.

5.3.4 A new perspective on play in public spaces

Barcelona plays things right

This measure ⊕, approved in February 2018, seeks to promote a change by recognising the social importance of play in public spaces and to transform these play areas so they foster free, autonomous play among children, while making them inclusive spaces, open to all ages, genders and cultures with general accessibility criteria. At the same time, it seeks to promote physical activity and contact with nature.

The installation of children's games in Plaça del Sol, in Gràcia, has proved a success, going by the use children are making of them.

Thus, between 2018 and 2019, 39 spaces are due to be renovated with new play criteria and elements of universal inclusion, creating 10 new play areas and 20 recreation spaces, of which 2 will be co-created with children: Parc de la Pegaso in Sant Andreu and Parc Central in Nou Barris.

In order to give shape to the measure and establish a working plan for the medium term, the City Council is adopting a participatory and cross-cutting approach and working with the Institute for Children and Adolescents to create the Plan for Play in Public Spaces in Barcelona up to 2030.

5.3.5 Municipal works with a lower environmental impact

Greening municipal works

The Technical Instructions for the Application of Sustainability Criteria in Public Works Projects ⊕ (2015) seek to minimise the environmental impact of municipal works and pursue energy self-sufficiency and environmental excellence in public space and construction projects. The instructions establish the application of the Mayoral Decree for Greening Public Works (2009), which calls for the production of an environmental report and a greening plan for actions with a budget equal to or higher than €450,000.

As a result, most construction, public space and infrastructure project contracts drawn up by BIMSA, which account for about half of all municipal works, include environmental criteria on the source of timber, energy and water self-sufficiency, increasing greenery and biodiversity, and promoting the circular economy.

Work is under way on amending the instructions to include actions arising from the government measure on the Transition towards Energy Sovereignty and the Climate Plan *(see Section 10.4.1, "New actions and objectives for continuing to make progress on greening the City Council").*

Sustainable urban planning workshops

With a view to incorporating socio-environmental criteria into the urban planning process that have a holistic, systematised and comprehensive vision of the city, the City Council has launched the sustainable urban planning workshops, several of which have been held with staff from different Urban Ecology Area departments taking part. At these sessions, the criteria for improving the approach to urban planning are assessed, analysed and defined by using a practical case as an example, with a view to obtaining an initial list of sustainability criteria and a methodology enabling them to be included in the urban planning process.

5.3.6 Coexistence in public spaces

New dog walking spaces

To comply with the 2014 Byelaw on the Protection, Ownership and Sale of Animals in Barcelona, which requires all dogs to be on leads in all spaces with the exception of the dedicated dog walking areas, the City Council set itself the target of ensuring that all the districts had a minimum dog walking space of 700 m^2. Five new areas have been created and two others renovated in 2018. Four more are due to be opened in 2019, enabling the target to be reached.

After a pilot test lasting two years, the space for dogs on the Llevant beach is now established and will open every year during bathing season. It covers 1,250 m, separated from the rest of the beach by fencing, and has a capacity for up to 100 dogs

Amendment to the terrace byelaw

The purpose of this amendment is to make the criteria required for authorising terraces more flexible as regards the percentages of pavement occupancy and free spaces.

To ensure universal accessibility, the byelaw establishes there must be a space of 1.80 m between the façade and the terrace which, "preferably", but not mandatorily, must be in front of the establishment. In the case of "emblematic" terraces that back onto the façade, accessibility alternatives will be studied.

In addition, the size of terraces on streets with raised pavements is more flexible. As a guide, a maximum occupancy of 50% is maintained, although it allows for them to occupy between 40% and 60% of the pavement, depending on each case.

5.4 Future goals and measures

With the involvement of residents, Barcelona City Council has implemented new projects to improve the habitability of public spaces, by pacifying them, promoting social uses and increasing greenery and biodiversity.

5.4.1 Actions to reclaim public spaces for residents and make them greener

Superblocks expand across Barcelona

In the coming years, the model of organising the public space in superblocks is expected to be rolled out across as much of the city as possible. Work is currently under way in three new areas: C/ Consell de Cent - C/ Germanetes (Esquerra de l'Eixample), C/ Girona and the surrounding area (Dreta de l'Eixample), and Sant Gervasi de Cassoles (Sarrià - Sant Gervasi), where a driving group has already been set up and work is under way on the Implementation Action Plan with the relevant groups: residents, schools, traders and facilities, among others.

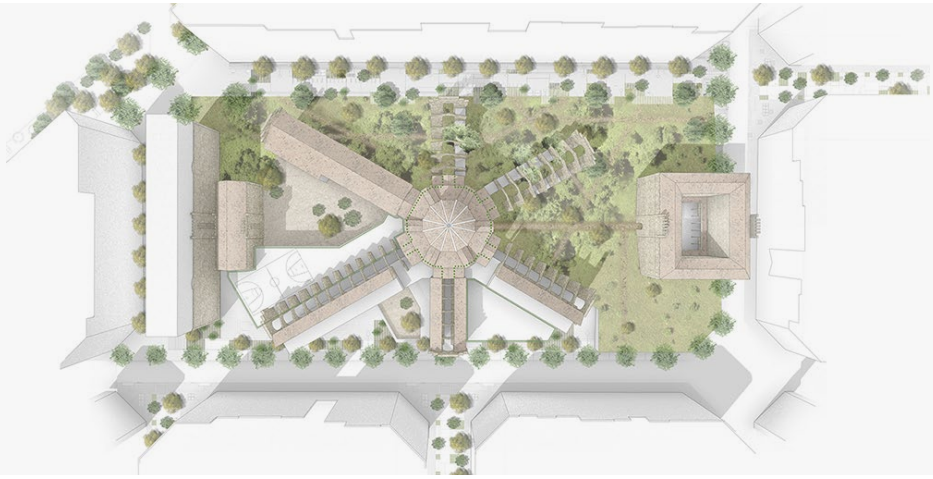
In addition, diagnosis work has begun in the following areas: in the area around Sagrada Família, Fort Pienc, the area around the old Model prison, Sant Andreu, Prosperitat, Sant Gervasi-Via Augusta and Poblenou.

La Model opens up to the city

After 113 years, the Model prison was closed in the summer of 2017 and handed over to Barcelona City Council. Following a participatory process involving local residents and entities, the City Council has drawn up a proposal to convert it into an open neighbourhood space and a facility hub for the city.

The transformation ⊕ process includes a school, a nursery, 150 council flats, an old people's home, a space for social and solidarity economy initiatives and a semi-underground sports centre. One of the galleries will be preserved as a memorial space, paying homage to its history, and a youth facility. All of that surrounded by 14,000 m^2 of green space. Work is due to start at the end of 2020.

The transformation of La Model must make the most of the large space which will be freed up for public use to create a new open park that will serve as a green lung for the surrounding area.



Boost to Parc dels Tres Turons

Barcelona has rekindled the development of Parc dels Tres Turons to consolidate it as a major green lung for the city. In September 2018, the City Council organised a call for tenders to give a unique vision to the overall improvement of this major green space spanning 123 ha. Ecological values will define the range of actions to be taken, so the future of the park will be decided by landscape criteria, along with greenery, water and energy management criteria.

The winners will be announced in March and will be asked to draw up the blueprints.

The new Rambla, reclaimed for the city's residents

In order to reclaim the Rambla and for Barcelona's residents to make it their own, work has been performed on the remodelling project in 2018. The proposed transformation drawn up by km-ZERO, in which residents and different institutions have been involved, provides for a series of cultural, social and planning measures.

Pedestrians will play a more prominent role on the new Rambla, with wider pavements and new places to sit and relax, while the space for vehicles will be reduced to a single lane. At the Drassanes end, a new urban space will be created, with places to sit and relax and two large green areas. Work is due to start at the end of 2019 or the start of 2020.

Can Peguera

The 2015 General Metropolitan Plan amendment has not affected Can Peguera's classification as a *barri de cases barates* or "cheap housing neighbourhood". In fact, it is the last of these neighbourhoods. Its land and buildings are all publicly owned and it conserves a low-density urban fabric with some very special characteristics, where memory and social structure play an important role.

When the decision was taken to conserve the neighbourhood, a lot of thought went into what its comprehensive renovation should involve, from the point of view of public spaces and facilities as well as the houses. As a result, energy renovation has also been included and the aim is to use the neighbourhood as an example of sustainable construction, adapted to current regulations and habitability requirements. This is reflected in the Future Plan, drawn up following an exhaustive diagnostics process and a lot of work with local residents.

5.4.2 Planning instruments for recovering local use of the coast

Coastal Plan

The City Council has started work on drawing up a strategic plan for the city's coastal areas, a tool for planning and managing the urban spaces on the waterfront. The plan covers the coastal neighbourhoods, ports, beaches, facilities and free spaces. The ultimate goal is to establish a new consensual approach to define strategic areas, proposals and specific actions that respond to each of the existing challenges along whole seafront, based on the concerns and needs of people that live, work and spend their free time there. To that end, a participatory process was launched in December 2018 with local residents, organisations and other entities affected.

The new Port Olímpic: a civic space dedicated to the sea

The Port Olímpic Master Plan has been drawn up with a view to leaving its current model of uses, based on night life and tourism, behind in order to reclaim the marina for resident uses and integrate it into the city.

The planned interventions will enable people to enjoy a public space of much higher quality, much more open and permeable, with better connectivity between the levels. For that, the marina breakwater will be traffic-calmed, vehicle access ramps will be removed and a new promenade will be built on the Moll de Gregal wharf. This will double the public space from the current 23,800 m^2 to more than 48,000 m^2.

Replanning its uses will boost nautical activities, sport and popular science, with a municipal water sports centre, a new centre for disseminating maritime knowledge and an expanded Sailing Centre.

The total investment will come to €39 million, which will be financed by the Port Olímpic itself through income from the sale of premises and moorings. Work is due to start at the end of 2019 and last until 2022.

Local air quality

Barcelona, cleaner air to guarantee the health of residents

Local air quality

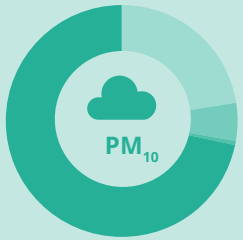
Vision of the future

Improving the quality of air breathed in the city

Current situation

Main sources of atmospheric pollution in Barcelona

- **69.0 %** by road traffic
- **9.5 %** by industry
- **8.7 %** by port activities
- **12.8 %** pby other sectors



- **71.7 %** by road traffic
- **0.7 %** by industry
- **5.2 %** by port activities
- **22.4 %** by other sectors

	NO_2 (current WHO annual limit: 40 µg/m³)	PM_{10} (current WHO annual limit: 40 µg/m³)	$PM_{2.5}$ (current WHO annual limit: 25 µg/m³)
Traffic stations	✗	✗	✗
Urban area stations	✓	✗	✗

✓ compliance
✗ exceedance

Lines of action

Planning "Programme of measures against atmospheric pollution" "Action Protocol for High Pollution Levels"

Reducing motorised transport "Low emission zone in Barcelona" "Superblocks and pacification"

Sustainable mobility "Public transport" "Bicycles" "Electric vehicles""

Effects on health "New monitoring system"

Information transparency and communication "Air quality website" "Alerts service"

6.1 Vision, challenges and opportunities

Vision of the future

Barcelona, like other European cities (Paris, London, Berlin or Rotterdam), exceeds the average annual NO_2 concentration limits established by the European Union and the recommendations of the World Health Organisation (WHO).

In terms of PM_{10} and $PM_{2.5}$ concentrations, although the annual European Union limits are being met, they remain above the reference levels set out by the WHO.

Therefore, Barcelona wants to improve the quality of air breathed in the city and ensure it stays within the maximum values defined by the European Union and the WHO. To achieve this, it is adopting structural measures to reduce the emission of polluting elements in the city with the main goal of decreasing average annual values and, at the same time, preventing episodes of high pollution. As traffic is the main contributing factor to the high level of certain atmospheric pollutants in Barcelona, it is essential that we move towards more sustainable mobility and become a city with fewer emissions and more greenery, in order to ensure the health and quality of life of residents.

All that means new action strategies must be adopted at all levels to improve the air quality in the city and the metropolitan area. The main challenges are as follows:

- **Barcelona is the heart of a major conurbation where around 8.2 million journeys are made per day.** Although the weight of ecomobility (journeys made on public and non-motorised transport, on foot or by bicycle) in total journeys has increased slightly, the high level of traffic on streets remains a problem that must be addressed.
- **Barcelona is the heart of a large urban system** with a high level of integration and inter-dependence between the city, the Barcelonès county, the metropolitan area and the metropolitan region, and there are constant dependencies and functional exchanges.
- **Barcelona has specific features on which the spread of pollution is dependent.** Firstly, the complex terrain where Barcelona is located encourages the accumulation of pollution. Secondly, on account of the density and height of buildings, there is a screen effect in terms of pollution generated by traffic. Thirdly, specific unfavourable meteorological circumstances compromise the atmospheric dispersion capacity of pollutants, increasing their concentration and causing one-off episodes of high pollution.
- **Barcelona is studying the relationship between health and atmospheric pollution.** The inhalation of suspended particles and nitrogen oxides released by combustion vehicles, diesel in particular, is associated with significant reductions in life expectancy. Scientific research on the impact of atmospheric pollution on health, the environment, noise, temperature and active transport represents an opportunity to achieve a healthy urban lifestyle.

6.2 General context and current situation

Emissions released by transport, those generated by the Port, industry and other sectors, such as the domestic and tertiary sectors, determine the level of atmospheric pollution in Barcelona. However, air pollution is also caused by emission sources some way away from the city, the so-called "regional contribution".

The Political Agreement to Improve Air Quality in the Barcelona Conurbation sets out, in the territorial scope of 40 municipalities, a series of actions in all sectors, in particular mobility, aimed at reducing NOx and PM_{10} emissions in order to re-establish air quality and meet the limits established in European legislation and gradually meet the limits recommended by the WHO. Guaranteeing the quality of the air we breath is equivalent to protecting health and the environment.

To reduce local atmospheric pollution levels, action must be taken on emission sources in the affected areas that, generally speaking and on a global scale, occur in economically dynamic urban hubs. The Action Plan to Improve Air Quality up to 2020, sets out additional environmental measures for these circumstances, which are called "environmental pollution episodes".

Some of the specific measures being implemented by the Catalan government to achieve the air quality targets set by the European Union include promoting, incentivising and boosting urban and intercity public transport; promoting modal exchange, energy diversification and the rational use of private vehicles; making vehicles on the roads greener and incentivising energy improvements.

The results of the studies drawn up as part of the Barcelona Air Quality Improvement Plan ⊕ (2015-2018) demonstrate that the mobility sector is the main cause of air quality problems in the city, both in terms of emissions and immissions. Although road traffic is not the main emitter in the city, it is the main contributor to NO_2 and PM_{10} immission levels, given the distribution of emissions across the city as a whole.

Origin of immissions (2013)	**NO_2** (average)	**PM_{10}** (average)
Background	13,0%	71,0%
Generated in Barcelona	87,0%	29,0%
Road traffic	60,0%	20,8%
Industry	8,3%	0,3%
Port activity	7,6%	1,5%
Other sectors	11,1%	6,4%

Traffic is the main cause of air quality problems in the city.

6.2.1 Consensual planning of urban mobility

Based on the source of pollution, the most effective strategy for improving air quality is to take action on road traffic and that is exactly what the Urban Mobility Plan ⊕ (PMU) is doing, to make further progress towards a model of safe, healthy, fair, smart and sustainable mobility. Barcelona is adapting its urban space to ensure a more equitable distribution for the various methods of transport, by opening cycle lanes, improving the bus network and giving priority to people travelling on foot, with wider pavements and traffic-calmed streets offering convenience and safety.

As part of the fight against air pollution, adopting coordinated action strategies at all levels (local, Metropolitan Area, Catalan government, Spanish government and European Union) is essential. Thus, the PMU fits in with and is adapted to current legislation and the various su-

pra-municipal plans, such as the Mobility Master Plan for the Barcelona Metropolitan Region (2013-2018) and the Metropolitan Urban Mobility Plan, currently being drafted. If we take into account the fact that 55% of the vehicles on Barcelona's roads are from outside the city, it is essential that planning for mobility and its consequences is carried out on a broader scale than the municipal level.

Likewise, the City Council has created the Committee to fight Air Pollution in Barcelona (2015) to address atmospheric pollution issues in cooperation with entities and players in the sector (municipal services, municipal groups plus different social, ecological, mobility, health and scientific entities and organisations), propose actions and define action protocols in the event of environmental pollution episodes. The necessary consensus between the municipal government, its social partners and the general public has a multiplying effect that can make a major contribution towards achieving a healthier city. The Barcelona Metropolitan Area (AMB) and the Catalan government (Generalitat) are invited to take part in the Committee as well, as a way of boosting inter-authority unity in the fight against air pollution. And the City Council plays an active role in the Barcelona Conurbation Air Quality Committee, as well as the working groups set up by the AMB and the Generalitat.

6.2.2 Failure to improve air quality in the city

The establishment of thresholds for each atmospheric pollutant seeks to avoid, prevent and reduce their harmful effect on human health. This principle is reflected in regional, Spanish and European atmospheric pollution legislation. The benchmark legislation in Spain to assess air quality is Act 34/2007, of 15 November, on Air Quality and Protecting the Atmosphere, and Royal Decree 102/2011, of 23 January, on Improving Air Quality.

European legislation also regulates and establishes legal limits on the concentration levels of carbon dioxide (CO_2), nitrogen dioxide (NO_2), fine suspended particles (PM_{10} and $PM_{2.5}$), tropospheric ozone (O3) and sulphur dioxide (SO_2). In addition to legal regulations, the WHO has also established limits on air pollution levels.

In order to make a representative assessment of the city's air quality, the Air Pollution Monitoring and Forecasting Network (XVPCA), jointly managed by the Catalan government and the Barcelona Public Health Agency, includes various measuring stations located according to the proxi-

The European Union has defined legal limits for the concentration of NO_2, PM_{10} and $PM_{2.5}$, and the WHO has established recommended limits for health, which in some cases, are tighter than the legal limits.

	European Union	**World Health Organisation**
NO_2	Hourly average: 200 µg/m³ Yearly average: 40 µg/m³	Hourly average: 200 µg/m³ Yearly average: 40 µg/m³
PM_{10}	24-hour average: 50 µg/m³ Yearly average: 40 µg/m³	24-hour average: 50 µg/m³ Yearly average: 20 µg/m³
$PM_{2.5}$	Yearly average: 25 µg/m³	Yearly average: 10 µg/m³ 24-hour average: 25 µg/m³

mity and gradient of emissions received. In all, there are 11 stations in Barcelona that measure the main elements which make up environmental pollution and which can affect people's health.

If we look at air pollution concentration data since 2001, we can see that the annual average concentrations of NO_2, PM_{10} and $PM_{2.5}$ have begun to rise again, following a gradual decrease in these pollutants, since 2011, when the effects of the financial crisis started to take hold in terms of the improvement in certain environmental parameters, such as air pollution or waste generation.

NO_2

As regards NO_2 throughout the period between 2001 and 2017, the health protection threshold set by the European Union and the reference level defined by the WHO have been exceeded at traffic stations and also, to a significant degree and generally speaking, at the urban background stations in Poblenou and Ciutadella. It is estimated that 70% of Barcelona's population are exposed to levels higher than those recommended by the WHO.

PM_{10}

With regard to PM_{10}, although the annual threshold defined by the European Union is being met, the annual reference value set out by the WHO is still being exceeded at both traffic and urban background stations. It is estimated that 98% of residents are exposed to levels higher than those defined by the WHO.

In terms of the daily limit (50 µg/m³), the number of days in which it has exceeded the daily reference level set by the WHO and the European Union has increased, both for traffic and urban background stations.

$PM_{2.5}$

Although the concentration of $PM_{2.5}$ remains below the annual limits set by the European Union for 2016 (25 µg/m³) and 2020 (20 µg/m³), it remains above the WHO reference levels.

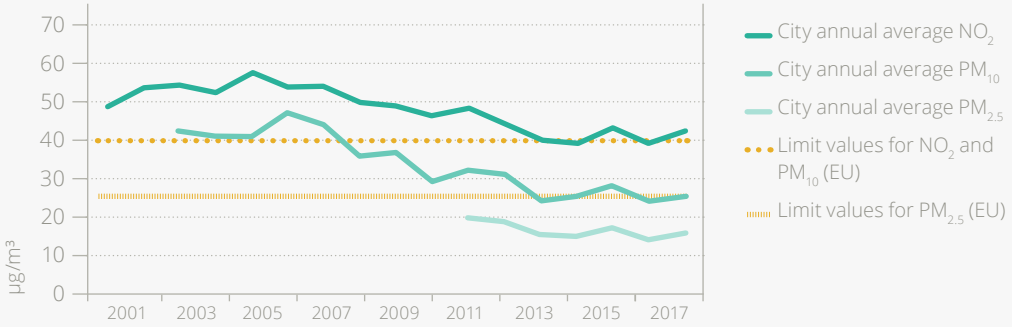
6.2.3 Atmospheric pollution by $PM_{2.5}$, cause of 424 deaths on average a year

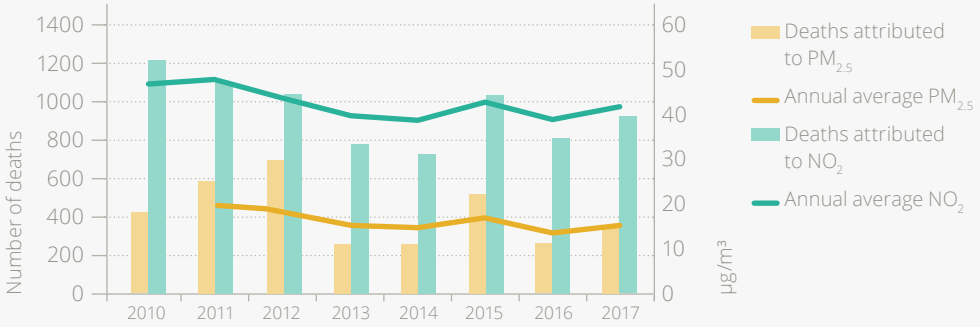
For a number of years, the Barcelona Public Health Agency has been analysing the impact of air pollution on the health of Barcelona's residents. Exposure to atmospheric pollution is directly related to a decline in health, in both the short and long term. Polluted air causes lung cancer, has clear effects on cardiovascular and respiratory diseases, contributes to the onset of asthma and diabetes, slows down foetal growth, delays brain development and pulmonary function in children and shortens life expectancy.

The results show how the impact on health caused by pollution over the course of the year is much higher than the impact caused by pollution episodes. Over the past 10 years, it is estimated that, had the level of 40 µg/m³ per day of NO_2 not been exceeded, on average 90 deaths and 67 hospitalisations for cardiovascular causes could have been prevented each year. In terms of the of $PM_{2.5}$ levels, had the level of 10 µg/m³ per day not been exceeded, 162 cardiovascular deaths and 1,368 respiratory illness emergencies could have been prevented each year. Thus, the measures must seek to permanently reduce motorised traffic.

In Barcelona, 424 deaths per year can be attributed to exceeding the $PM_{2.5}$ thresholds recommended by the WHO. In the case of NO_2, this figure increases to 961 deaths.

The data trend in this period establishes a correlation between the level of pollution and deaths it causes. The years in which the density of fine particles was highest ($PM_{2.5}$) were when there were the most deaths, 594 (2011), 706 (2012) and 529 (2015).





6.3 Measures implemented to improve air quality

Motorised transport is the main source of atmospheric pollution, as it is the main contributor to NO_2 and PM_{10} immission levels. Thus, to improve air quality in the city and protect residents' health, measures must be applied that are specific to each neighbourhood, the city as a whole and the metropolitan area to gradually reduce the number of vehicles on the road and facilitate the switch to more sustainable methods of transport. In recent years, the City Council has promoted a series of measures that encompass different sectors involved.

6.3.1 Planning to reduce atmospheric pollution

Programme of Measures to Control Air Pollution

Given the results of the air quality assessment in Barcelona in 2015, which suggested that atmospheric pollution in the city had not only not been curbed but that it had increased and the main culprit was road traffic, the City Council drew up the 2015-2018 Barcelona Air Quality Improvement Plan and, in 2016, the Programme of Measures to Control Air Pollution. The measures seek to reduce the levels of the two most problematic pollutants currently in the city: suspended PM_{10} particles and nitrogen dioxide (NO_2). Based on a time horizon set for 2020, 58 actions have been defined.

High Pollution Action Protocol

This protocol, approved in January 2018, is an internal coordination instrument included in the Basic Municipal Emergency Plan that regulates the actions to be taken when high levels of NO_2 and PM_{10} pollution are detected.

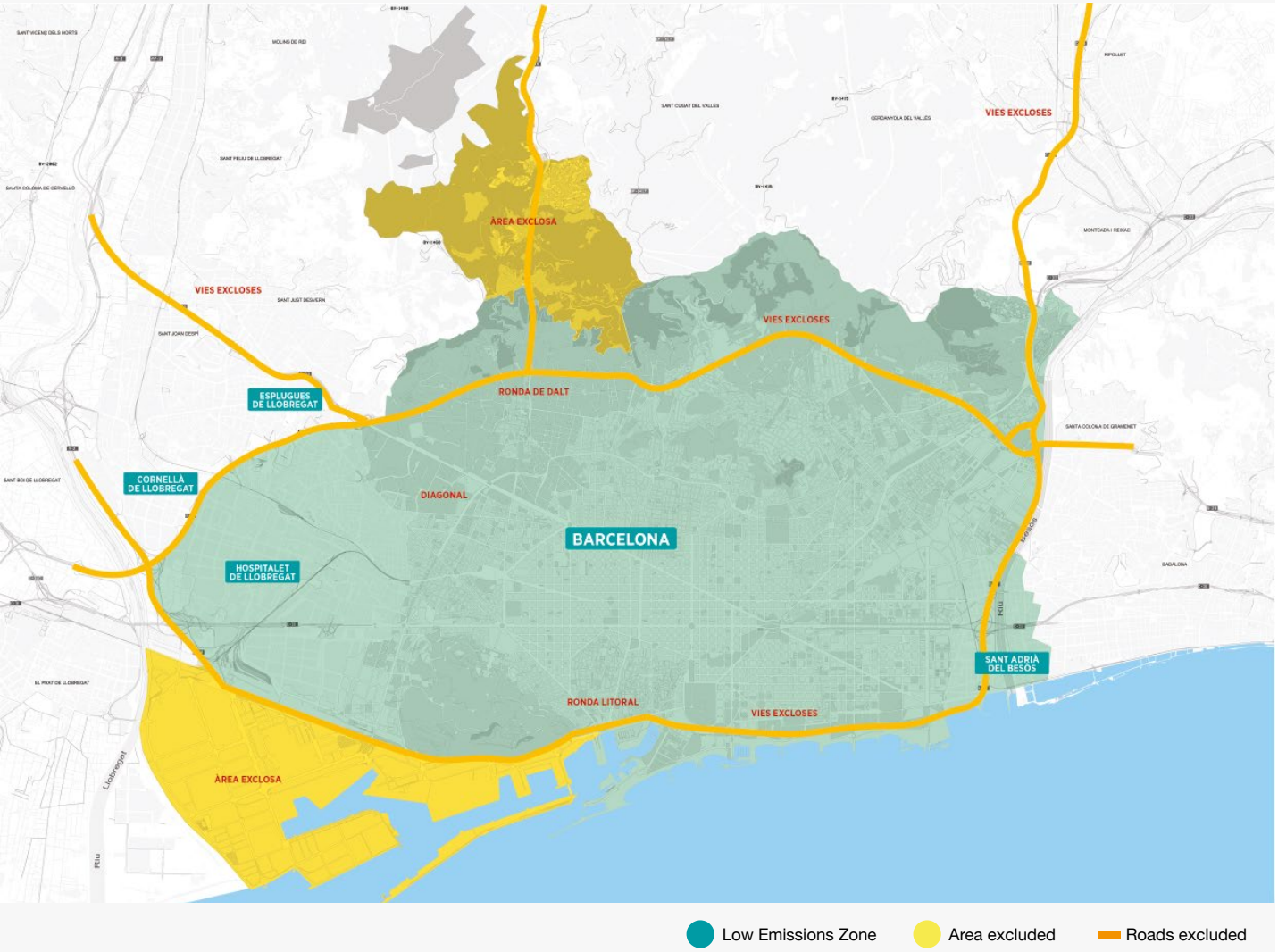
It establishes that, in the event of an NO_2 episode, temporary restrictions shall apply to the circulation of the most polluting vehicles in the low emission zone within the Barcelona ring roads and that, to facilitate user mobility, extraordinary measures shall apply to public transport, namely a 10% increase in the overall supply of public transport in the metropolitan area or the activation of the T-aire card.

6.3.2 Reducing motorised transport, key to improving air quality

Restrictions on the circulation of the most polluting vehicles

Thanks to the joint efforts of Barcelona City Council, the Barcelona Metropolitan Area and the municipalities within it, since December 2017, during NO_2 environmental pollution episodes on working days from Monday to Friday, between 7 am and 8 pm, passenger vehicles not showing the DGT label and vans prior to Euro1 cannot travel in the low emissions zone within the Barcelona ring roads, an area spanning more than 95 km^2 which includes Barcelona (with the exception of Vallvidrera, Tibidabo and Les Planes, and the industrial area of Zona Franca) and parts of Sant Adrià de Besòs, Hospitalet de Llobregat, Esplugues de Llobregat and Cornellà de Llobregat.

From December 2018 onwards, this restriction shall expand to motorbikes, scooters, motorbikes and quadricycles that do not have the DGT label. It is expected that this will gradually apply to all types of vehicles, with a view to implementing the structural measure from 1 January 2020.



Regulated parking

In the event of a pollution episode, it is also planned that on-street parking rates will increase for non-residents in blue and green zones to €2 an hour for all vehicles, with the exception of those with the DGT "Zero Emissions" label, which will be charged €0 an hour. This measure will take effect when the corresponding changes to current parking meters have been applied.

Changes in the city model

The roll-out of superblocks in four city districts and the implementation of other traffic-calming measures, such as those on Avinguda Meridiana or Carrer de Pere IV, for example, make it possible to increase the space for non-motorised mobility and reduce atmospheric pollution *(see Section 5.3.2, "Urban transformation towards a city for people").)*.

Park & Ride

Barcelona de Serveis Municipals (BSM) has four Park & Ride ⊕ locations on the outskirts of the city (Plaça del Fòrum, Rius i Taulet, Sant Genís and Marquès de Mulhacén). This type of car park is set up close to public transport stations with a view to drivers parking their private vehicles and travelling to the city centre using public transport.

6.3.3 Fostering sustainable mobility

Fostering public transport and bicycles

To encourage people to leave their private vehicles for sustainable, public transport, the new orthogonal bus network has been completed, new bus lanes have been created, the metro network has been expanded with the opening of the L10 Sud (south line), the cycling infrastructure has been expanded, as has the Bicing network, and other measures have been adopted to promote cycling *(see Chapter 3, "Mobility and urban transport").*

Promoting electric vehicles

In accordance with the Electric Vehicle Master Plan (2016), the following actions have been taken to promote the use of electric vehicles: free parking in green or blue zones for users of electric vehicles, 75% rebate on mechanically powered vehicle tax, and the creation of 450 public and free recharging stations *(see Section 3.3.4, "Private vehicles, limited and sustainable").*

Discounted public transport

Two new public transport cards were created in 2017. The T-verda provides for unlimited, free travel for three years on public transport in the six tariff zones operated by ATM. It can be obtained by anyone who can demonstrate that they have scrapped a polluting vehicle without the DGT environmental label.

The T-aire is a special card for use on days when the NO_2 pollution-related environmental episode protocol is activated. The price is the same as two journeys with the T-10, and a 10% discount is applied.

6.3.4 Municipal service vehicles, increasingly cleaner

Making the municipal vehicle fleet greener

The City Council is working to make the municipal vehicle fleet a low emission fleet: currently, 24% of vehicles are electric (703) and 7% are hybrid (208). In 2017-2018, 217 electric vehicles and 166 hybrid vehicles were acquired, 58% of all acquisitions. This is the result of applying the Technical Instructions for the Application of Sustainability Criteria in Vehicles ⊕ (2015), which establish a range of priorities in the motorisation of vehicles.

More specifically, by making cleaning and waste collection contracts in Barcelona greener there has been a notable reduction in the environmental impact of the municipal vehicle fleet. In 2018, 94% of contract vehicles were powered by low environmental impact technologies, including biofuels. (If they are excluded, the figure is 62%). Twenty-two per cent of the fleet are electric vehicles.

6.3.5 Actions coordinated with other sectors

Port and airport, committed to air quality

The Port of Barcelona has taken actions to help improve air quality, such as the incorporation of discount schemes for the cleanest vessels or the installation of a liquefied natural gas (LNG) point for lorries and other vehicles. Furthermore, the City Council has signed the declaration for creating an emission control area in the Mediterranean, bearing in mind that maritime pollution is responsible for 9% of nitrogen oxides (NOx) in the city's air.

As regards the airport, which has four air pollution measuring stations, it is worth highlighting the gradual replacement of fossil-fuel vehicles with electric vehicles and the optimisation of aircraft taxiing operations.

Corporate Travel Plan

The Metropolitan Transport Authority, in which Barcelona City Council participates, is promoting the adoption of the Corporate Travel Plan ⊕ (PDE). This is a series of actions intended to optimise the mobility of workers and visitors, encourage the use of alternative modes of transport to private vehicles, rationalise the use of cars and manage the goods transport.

6.3.6 Monitoring the effects of atmospheric pollution on health

New monitoring system

The Barcelona Public Health Agency has developed a monitoring system that makes it possible to measure, monitor and report the effects of air pollution on the health of Barcelona's residents. The new system makes it possible to estimate the impact of pollution on health, both in the event of an episode and by exposure over the course of the year, in addition to estimating deaths attributable to atmospheric pollution.

6.3.7 Information transparency and communication

Environmental education and awareness raising tools

Actions targeting different groups of people have been rolled out as part of a communication programme. Worth particular mention is the creation of an air quality website with a map that provides information on current and forecast concentrations of NO_2 and PM_{10}; a free atmospheric pollution alerts service via email; the guide *Mobility and Air Quality* and an educational package with a range of educational activities for teachers or different subjects and levels of education.

In cooperation with the Barcelona Public Health Agency and the Barcelona Education Consortium, the "Breathing Schools" programme was created in 2018 with a view to reducing pollution around schools and improving awareness of the problems pollution poses to the school population.

6.4 Future goals and measures

Improving the quality of the air inhaled each day in Barcelona and achieving the acceptable levels allowed by legislation is the main priority that will mark the implementation of future structural measures and policies in having a positive impact on human health and the environment.

The institutional commitment acquired at the 2017 Air Quality Summit to reduce atmospheric pollution and improve air quality between the Catalan Government, Barcelona City Council, the Barcelona Metropolitan Area, the Barcelona Provincial Council and 40 local representatives, establishes two strategic lines that must be followed: restricting use of private vehicles and incentivising public transport to reduce emissions linked to transport by 30% in the coming 15 years.

6.4.1 Towards zero-emission mobility

Widening the restrictions in the low emissions zone

If the targets in the new Urban Mobility Plan and the Air Pollution Concrol Plan are achieved, one in five private vehicles will stop driving on Barcelona's streets between now and 2020.

From 1 January 2020, the circulation of all vehicles without the DGT label will be banned on workdays from Monday to Friday, between 7 am and 8 pm. As of 1 January 2025, this ban will extend permanently to all the municipalities within the Barcelona Metropolitan Area.

As demonstrated by the 2017 study ⊕ charactering vehicles and their emissions in the metropolitan area, acting on 20% of vehicles on the roads has an effect on 60% of immissions in the city.

Promoting more sustainable means of transport

One of the main aspects of the 2019-2024 Urban Mobility Plan is sustainable mobility, in other words, facilitating the switch to more sustainable means of transport and transport energy consumption, in addition to increasing the proportion of renewable and clean energy consumed. The new plan will focus on promoting travel on foot, by bicycle and on public transport over travel by private vehicles *(see Section 3.4.1, "Strategic planning of mobility over the coming six years).*

Consolidation of the superblock model

Another action to improve the city's environmental quality is to continue making progress on reorganising the public space by consolidating the superblocks. These urban structures reduce through traffic on certain roads and allow for a traffic-calm city with more green spaces, in other words, a city with cleaner air *(see Section 5.4.1, "Activities to restore public spaces to residents and making them greener").*

Acoustic quality

Barcelona is reducing noise pollution to become a healthier city

Acoustic quality

Vision of the future

Improving Barcelona's acoustic quality to become a healthier city

Current situation

During the day

Traffic, the main source of noise

22.8 % of the population exposed to

> 65 dB (A)

Road length exposed to >55 dB (A)
2012: 89.2%
2017: 80.2%

Road length exposed to >65 dB (A)
2012: 42.7%
2017: 33.5%

At night

Traffic, the main source of noise

32.6 % of the population exposed to

> 55 dB (A)

Road length exposed to >45 dB (A)
2012: 90.9%
2017: 87.5%

Road length exposed to >55 dB (A)
2012: 58.9%
2017: 51.3%

Lines of action

Assessment and planning
"Plan to reduce noise pollution"
"Strategic Noise Map of Barcelona"
"Noise and Health working group"

Control and monitoring
"Sound level meters in public spaces" "Sound limiters at festivals and concerts"

Awareness raising amongst residents
"Barcelona Sona"
"Pilot tests in popular night-life areas"

Education at schools
"Sssplau More Sustainable Schools micro network"

7.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to improve the city's acoustic quality to live in a healthier environment. Like all major cities, the sound of Barcelona is like the beating of a drum. This sound becomes noise when it exceeds thresholds that can affect the peace and relaxation of residents. This noise undermines the quality of our surroundings and has a demonstrable impact on our health. Planning and civility are the main pillars for achieving well-being and reducing decibels.

Reducing noise pollution has been one of Barcelona City Council's environmental objectives for more than 20 years and the aim is to invert the general trend of gradually rising noise levels in large urban hubs. This trend is compounded by the challenges posed by the geographical, historical and cultural features of an eminently Mediterranean city like Barcelona. On the other hand, growing awareness of the issue has opened up a wide variety of opportunities to overcome this challenge.

- **Barcelona is a dense city with a high density of vehicles**. This means that a high percentage of the population is exposed to very high levels of noise.
- **Noise is a risk factor for health that is often underestimated.** In addition, noise perception is subjective and can have different impacts on different people.
- **Public awareness of noise has gradually increased,** so the City Council is making efforts to improve the city's acoustic quality by rolling out a wide variety of actions.
- **Night-life is no longer a localised, seasonal activity** but now part of life in more districts and is present all year round.
- **The intensification of tourist activities has increased noise pressure** generated by traffic, the use of public spaces and leisure activities that involve tourists. Furthermore, the proliferation of tourist apartments makes it difficult to control and take action against these sources of noise. Regulating these activities must make it possible to act more effectively and arrange these activities in such a way that respects the rights and duties of everybody.
- **The new Strategic Noise Map enables us to get a better understanding of noise in the city** and represents an opportunity to adopt more effective measures for reducing noise pressure on residents.
- **Noise pollution regulation and control actions are having a positive and notable impact** on reducing noise levels.
- **Improving noise quality is a cross-cutting objective in the city.** Noise management is not only addressed by ad hoc policies. It also fits in with the Council's other policies, such as promoting electric vehicles and sustainable mobility, creating superblocks or covering major infrastructures.

7.2 General context and current situation

Barcelona is a soundscape made up of sounds from multiple sources, ranging from nature to the roar of an engine. The flurry of activities, both day and night, means that noise levels can undermine the quality of life of city residents. There is considerable evidence that associates exposure to noise with effects on health, such as sleep disturbance, stress and risk factors that can lead to cardiovascular diseases. In that sense, sound management is a priority for ensuring people who live in and use the city enjoy a healthy environment.

In recent years, public awareness has increased, so Barcelona City Council is making efforts to improve the city's acoustic quality by rolling out a wide variety of actions. These efforts are reflected in the Strategic Noise Map ⊕, which has recently been updated, and the 2010-2020 Noise Pollution Reduction Plan ⊕.

The regulatory framework rolled out in recent years in Catalonia, Spain and Europe regulates aspects such as the methodology for measuring noise levels, urban zoning based on noise immission thresholds and the duties of central and local government as regards managing noise. Supra-municipal agglomerations of more than 250,000 inhabitants must produce (and revise every 5 years) strategic noise maps and the corresponding action plans to reduce noise pollution, particularly in areas where the limits set out in the regulations are exceeded. At a municipal level, the Barcelona City Council Environment Byelaw (OMA) ⊕ establishes the regulations aimed at preventing and monitoring noise pollution and setting criteria for good noise quality in the city. The OMA also establishes immission limits that apply to each noise sensitive area.

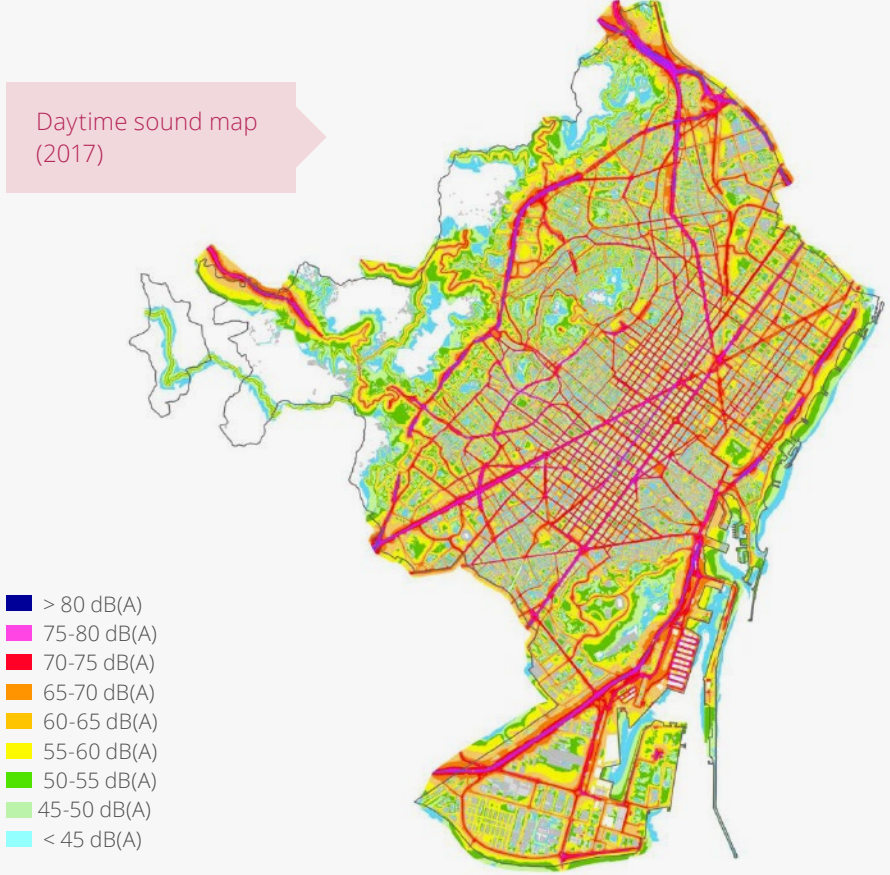
In certain noise sensitive areas, the immission threshold increases by 5 dB(A) for existing urbanised areas.

	Thresholds recommended by the WHO
Outdoor, day	65 dB (A)
Outdoor, night	40 dB (A)

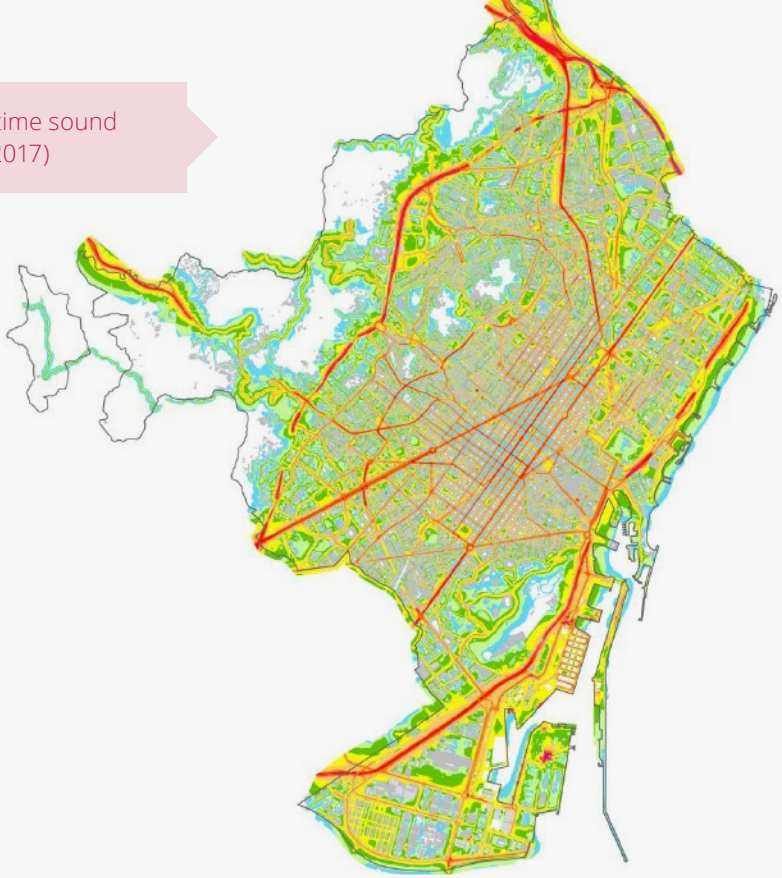
Immission thresholds established by the Barcelona City Council Environment Byelaw

	High noise sensitivity area	Moderate noise sensitivity area	Low noise sensitivity area
Outdoor, day L_d (7 am to 9 pm)	60 dB (A)	65 dB (A)	70 dB (A)
Outdoor, evening L_d (9 pm to 11 pm)	60 dB (A)	65 dB (A)	70 dB (A)
Outdoor, night L_d (11 pm to 7 am)	50 dB (A)	55 dB (A)	60 dB (A)

Daytime sound map (2017)



Night-time sound map (2017)



7.2.1 Traffic, the main source of noise in the city

Data from the new Strategic Noise Map demonstrate that traffic is by far and away the main source of noise in Barcelona both during the day and at night. However, it is so pervading that it has become an environmental noise to which we have become accustomed and it no longer generates complaints like other more one-off, localised sources of noise do. The perception residents have is that nightlife causes the most nuisance, despite being the second objective cause of noise.

Noise caused by night-life is mostly caused by people travelling through an area to reach night spots and by the agglomeration of people in public spaces in these areas. The noise generated outdoors from inside these venues is irrelevant considering the control and corrective measures required by the City Council. In some areas, especially Ciutat Vella, night-life is a factor all year round, regardless of the season.

7.2.2 Updated noise map

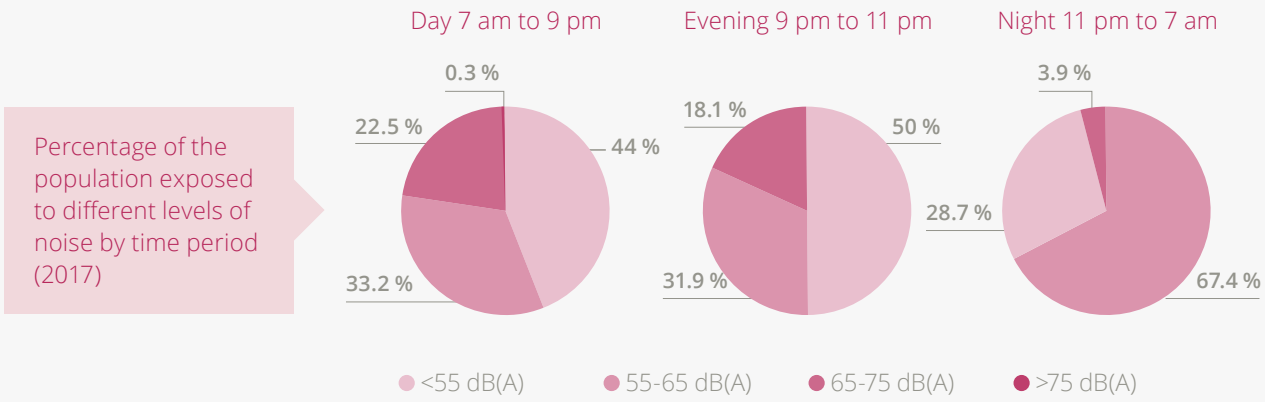
Data from the new map, gathered in 2017, suggest that the percentage of the population exposed to average and high levels of sound during the day, more than 65 dB(A), is 22.8%. At night, this percentage rises to 32.6%, taking levels of more than 55 dB(A) as a reference. The districts with the highest percentage of exposure to these noise levels, both during the day and at night, are Eixample, Gràcia and Les Corts.

These values cannot be compared with previous editions of the map, as a new European methodology has been rolled out for assigning residents to different noise levels, which distinguishes homes according to whether they face the street or block interiors. In addition, it is based on a more accurate identification of block interiors and characterisation of their uses, meaning that almost 4,000 block interiors are now taken into account, instead of 1,000.

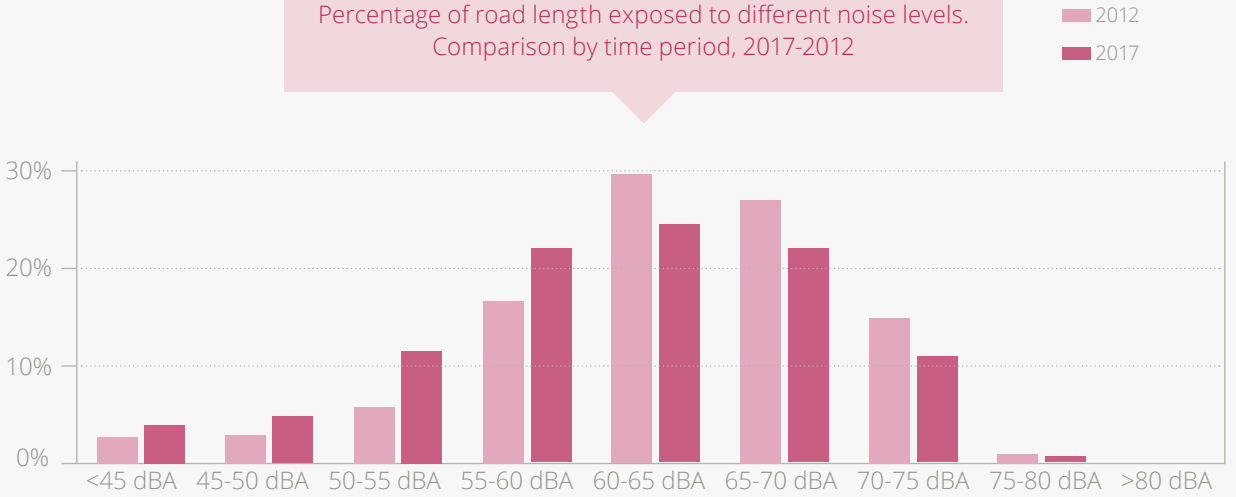
By contrast, the results concerning sections of streets exposed to noise are comparable. Both during the day and at night, the general trend in comparison to 2012 values is a decrease in the streets exposed to high levels of noise. During the day, the road length exposed to noise of more than 55 dB(A) has decreased from 89.2% in 2012 to 80.2% in 2017. At night, the change registered over the same period for exposure to noise of more than 45 dB(A) has been from 90.9% to 87.5%.

The factors that have contributed to this improvement have been the changes in the layout of the city, creating more space on pavements and in pedestrianised streets, the increase in users of sustainable methods of transport, the reduction in industrial sites and their levels of activity, and a lower percentage of overground railway lines.

Percentage of the population exposed to different levels of noise by time period (2017)



Percentage of road length exposed to different noise levels. Comparison by time period, 2017-2012



7.3 Measures implemented to improve acoustic quality

The City Council's objective is to improve the acoustic quality of the city by means of a comprehensive approach in all municipal areas, with cross-cutting actions that embrace mobility, public works, night-life and information and awareness raising tools.

7.3.1 Assessment and planning tools for defining the action plans

A new more accurate and detailed strategic noise map

The City Council has updated the Strategic Noise Map of Barcelona ⊕, which reflects the noise situation in the city and provides an idea of progress over the past five years. The Strategic Noise Map combines the map of the existing noise situation, which geolocates the noise values measured, and the noise capacity map, which classifies each section of road depending on the target noise quality value. With the methodological improvements and technological advances applied in creating the new map, we now have more accurate and realistic information on noise levels in the city, making it possible to assess the impact of noise pollution reduction measures better.

A working group on the relationship between noise and health

Besides the work to update the Strategic Noise Map, the "Noise and Health in Barcelona" working group was set up at the end of 2017 . The objective of this group was to discuss the noise situation in the city and its direct impact on the health of city residents, as well as contributing to resolving the problems detected. The idea is to outline the situation, share what is being done and decide what more can be done, globally and across the board, by all those involved, in order to adopt measures and take specific action for each activity sector that can reduce noise levels in the city.

The group's conclusions and the results of the new Strategic Noise Map will serve as the basis for creating the new 2020 Noise Pollution Reduction Plan.

An action plan that works

The measures set out in the Noise Pollution Reduction Plan ⊕ are effectively contributing to a gradual improvement in the city's acoustic quality. Apart from the actions to reduce traffic included in the new urban plans for the city, a series of actions have been implemented and consolidated that range from controlling and regulating noise generated by various activities to raising public awareness of this problem.

Main milestones of the Noise Pollution Reduction Plan

→ Noise Pollution Control and Monitoring System. A total of 125 measuring devices have been set up in various public spaces to constantly measure sound levels. These enable us to monitor noise levels in some city leisure areas, carry out mobility studies (traffic, buses, trains, etc.), update the noise map, monitor implementation of the superblock scheme, evaluate activities that cause conflict and so on.

The network of outdoor sound level meters, comprising fixed and mobile sensors, makes it possible to monitor sound levels in the city.

- Installation of sound limiters at festivals organised by the City Council. Between 2015 and 2017, the noise was kept down at 2,166 concerts, and in 2018, at more than 1,000 concerts and 414 events.
- Carrying out acoustic characterisation studies in various places to find out the best location and layout of concert stages, bar terraces and/or the acoustic feasibility of holding these types of activity in such spaces.
- Carrying out sonometric inspections of premises:: 350 a year.
- Remote management of sound limiters installed in city establishments open to the public, as well as sealing off TVs and Hi-Fi systems. Currently 653 activities are monitored and another 100-150 are added every year.
- Reports on acoustic conditioning projects, measures to check event sound levels, sealing off limiters.
- Response to complaints from residents. The districts respond to residents and around 1,500 inspections are carried out each year. Control measures are also applied to ensure proposals for activities to be held in public spaces are accompanied by the corresponding acoustic reports.

The Ciutat Vella Uses Plan takes noise into consideration

During the process of drawing up the current Ciutat Vella Uses Plan, the Barcelona Public Health Agency carried out a Study to assess the impact of noise from nighttime leisure activities on the health of people in Ciutat Vella. This was the first comprehensive sound X-ray of the district in order to assess the impact of nightlife noise on local residents' health and quality of life.

Among the wide range of actions carried out, cleaning and waste collection times at night have been changed to protect residents' rest time, following a pilot test in Carrer d'Escudellers in the summer of 2017.

7.3.2 Information and raising public awareness for less noise and respect for others

Campaign to reduce noise caused by nightlife

The aim of this campaign, which has been carried out every year since 2001, is to work on joint responsibility with the noise generators and residents. It calls for collaboration through awareness raising, information and education to continue making progress with the strengthening of coexistence.

More specifically, the following actions are carried out by the team of promoters from June to October: informing residents, handing out campaign material, informing nightlife venues and asking them to support the campaign by putting up their campaign collaborator sticker and monitoring public spaces. The areas targeted include the areas round street terraces and the entrances and exits to various venues as well as public spaces. The districts where most work is done include Eixample, Sants-Montjuïc and Gràcia, and the Gothic and Sant Pere, Santa Caterina i la Ribera neighbourhoods in Ciutat Vella.

During 2018, more than 70,000 residents and over 20,000 tourists received information and around 77,000 lollipops were handed out, in addition to other merchandising material.

Pilot tests for reducing noise caused in public spaces at night

Plaça del Sol is a public square in the Gràcia district that suffers from a high level of noise pollution. In 2018, a pilot campaign was organised involving a series of activities to improve acoustic quality. The most notable ones included a programme of activities and play area for children in the square; the fixed police presence from Sunday to Thursday during the spring and summer months; a campaign to raise awareness of noise caused by nightlife; drawing up a study to quantify the sound levels generated by each of the acoustic focal points in the square and, above all, to establish the percentage of noise generated by terraces and the percentage generated by other people occupying the public space.

Discovering Barcelona's sound heritage

Each year, the City Council organises a series of activities to commemorate International Noise Awareness Day (held on the last Wednesday in April), including "Barcelona Sona", held simultaneously across ten of the city's districts. People are invited to discover the sound of the hidden beauty in our sound heritage, for example, the bubbling of a fountain or the ringing of a bell, which are often masked by traffic noise. These sounds are recorded in a synchronised manner and then included in the More Sustainable Barcelona Map, a virtual platform that collects social and environmental initiatives in the city. This initiative enables residents to discover how Barcelona really sounds.

'Sssplau', an educational idea to raise awareness of noise

This project, which is part of the "More Sustainable Schools" programme, seeks to raise school students' awareness so they participate in improving the sustainable management of their surroundings. Following an analysis of the circumstances of each school, it seeks to identify spaces and times of the day that are more problematic in each one, identifying the noises, understanding their impact on health and learning and looking for a compromise to take joint actions that can improve acoustic quality. Participating schools produce noise maps for the school and the surrounding area and monitor sound levels using a network of luminous displays. The project was first run in the 2014-2015 school year and in 2017-2018, 17 schools took part.

Campaigns for reducing noise caused by vehicles

Since 2005, the City Council has organised campaigns to reduce the noise generated by vehicles, through voluntary controls at different locations across the city to measure the noise they generate, and how their owners can be made aware of it and adopt the corresponding measures.

More than 300 motorbikes took part in the two campaigns in 2018 (161 in the first and 278 in the second).

7.4 Future goals and measures

7.4.1 A new strategy for improving noise quality in the city in a participatory manner

Assessment of the Noise Pollution Reduction Plan

Given the Noise Pollution Reduction Plan is due to come to an end in 2020, it is planned to assess and update it with the following objectives in mind:

- Include new actions that respond to the new needs that have arisen in the city.
- Place greater emphasis on the executive part: draw up specific plans for areas that exceed the thresholds.
- Assess the effectiveness of measures implemented and redirect actions that have not obtained the expected results.
- Simplify the plan to make it more agile, grouping actions shared with other plans (such as the Urban Mobility Plan) and explaining the synergies.
- Rethinking priorities, time frames and indicators.

Monitoring noise in superblocks

Noise monitoring is expected to take place in eight superblocks, which are currently at different stages: Poblenou, Sant Antoni, Maternitat i Sant Ramon, Horta, Hostafrancs, Consell de Cent - Germanetes, Carrer de Girona and the surrounding area, and Sant Gervasi de Cassoles.

Waste prevention and management

Barcelona, towards zero waste

Waste prevention and management

Vision of the future

Achieve zero waste by not generating waste but 100% harnessable resources

Current situation

Waste generation

2013 **730,285 t**

2018 **799,981 t**

2013 **1.23** kg/inhab./day

2018 **1.36** kg/inhab./day

Selective waste collection

2013 **32 %**

2017 **36 %**

Green points

2013 **741,086** visits

2017 **942,164** visits

Level of improper waste in the organic fraction

Domestic:

2013 **21.10%** ↓ 2018 **15.61%**

Commercial:

2013 **8.44%** ↓ 2018 **6.91%**

Waste treatment

55.8 % Mechanical and biological treatment

35.5 % Material recovery

4.5 % Energy recovery

4.2 % Controlled landfill

Lines of action

Planning "2012-2020 Municipal Waste Prevention Plan" "Zero Waste strategy"

Prevention "Remenja'mmm" "More Sustainable Schools: Waste Prevention Plan, More Sustainable Wrappers, We eat it all!" "Repair workshops"

Reuse "Reusable drink cups" "Reusable bottles" "Renova campaigns"

Selective waste collection "Door-to-door in Sarrià" "New cleaning and collection contract"

8.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to achieve zero waste: not generate waste but 100% harnessable resources. From the perspective of a circular economy, less waste will mean more opportunities and better conditions for increasing the amount and quality generated, enabling it to be reincorporated as resources in production cycles or natural systems. Waste prevention must be based on a gradual and profound change in consumption models and habits. Therefore we must continue raising awareness and promoting joint responsibility between the public and other social and economic players.

The environmental impacts deriving from the current consumption model mean that waste prevention is a primary issue. Refraining from generating waste entails avoiding the additional consumption of resources, whether by manufacturing new products or managing waste generated. The challenge of obtaining zero waste, reducing waste generation by promoting selective waste collection, the prevention, recovery and reuse of resources and raw materials involves creating a new consumption culture that promotes the adoption of low waste generation habits and, at the same time, facilitates progress towards a circular economy. To achieve these objectives, a series of important challenges must be overcome. Therefore, harnessing the opportunities offered in the new regulatory, social and technological context is essential.

- **Upturn in waste generation and stagnation in source separation habits,** while regulatory targets are increasingly more demanding. However, new targets and regulatory changes for certain products are expected, such as single-use plastic items, which may boost the transformation of consumption habits and waste generation.
- **Reuse is still very much a minority approach.** Nonetheless, the general public's perception can be changed in favour of waste prevention and reuse by using communication strategies based on their inherent social and environmental values as well as the more classic economic and commercial appeals. The fledgling roll-out of exchange and repair networks must be consolidated with a new method for harnessing resources that does away with the disposable culture.
- **The diversity of the urban fabric, vitality, uses and demographic composition** of Barcelona has an impact on the quality and quantity of selective waste collection and how clean the city is. The model the new contract proposes, which will govern these services in the coming years, provided for flexibility mechanisms to adapting cleaning and collection systems to the circumstances of each neighbourhood with efficiency and effectiveness criteria.
- **The incorporation of smart and innovative technologies** will make it possible to improve the way waste collection works; to obtain more knowledge on which to base solutions; to decrease the environmental impact of management, and increase its transparency.

8.2 General context and current situation

The vitality and diversity of a city like Barcelona calls for considerable effort in cleaning and waste collection. Responsibility for cleaning public spaces and municipal waste is assumed by Barcelona City Council and these services are carried out by means of management contracts and agreements with social entities and companies. But this responsibility is shared with all residents and organisations in the city, as proper management of waste starts by generating as little waste as possible and cleaning public spaces starts by not getting them dirty in the first place.

Cleaning and waste collection policies and services are implemented in accordance with the management hierarchy established by the Framework Waste Directive, which prioritises, in the following order, prevention, preparation for reuse, material recovery (or recycling, including composting), other types of recovery (such as energy recovery) and elimination (including incineration and controlled disposal in landfills). At a European level, the recently approved regulatory changes establish very ambitious targets in terms of municipal waste prevention and recycling. These are, for the most part, already included in waste prevention and management plans for Catalonia, the Barcelona Metropolitan Area and Barcelona City Council.

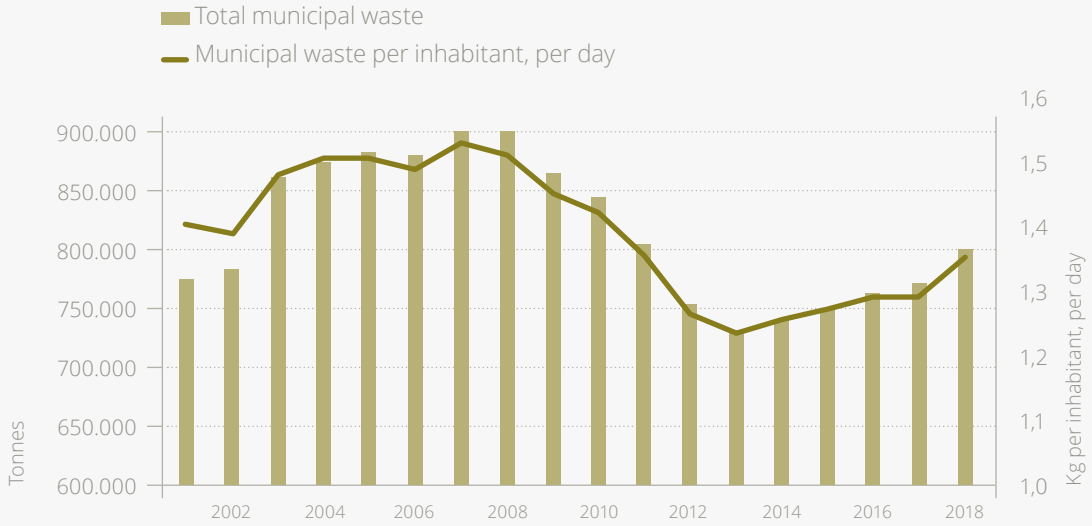
The Programme for Waste Prevention and Resource Management Programme in Catalonia (PRECAT20) puts the emphasis on waste prevention, with a target or reducing waste by 15% and food waste by 50%. The milestones in terms of recycling and harnessing waste go one step further than the European regulations currently in force, setting a target for increasing selective municipal waste collection in Catalonia of 60% by 2020.

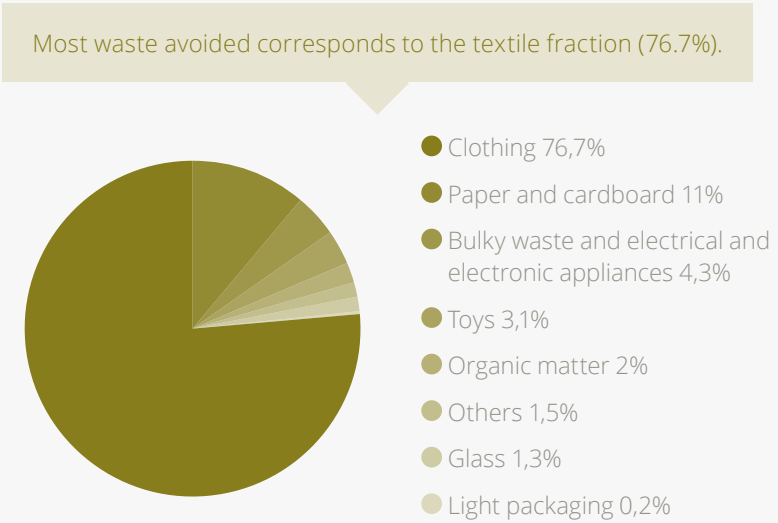
The 2017-2025 Metropolitan Municipal Waste Management Programme, which is currently being drawn up, reinforces these targets and introduces a focus on the circular economy, the prevention and reuse of waste, the principles of *zero waste* and recognition of waste prevention and management as a tool for mitigating climate change. Finally, the 2012-2020 Barcelona Municipal Waste Prevention Plan, in collaboration with the "Zero Waste" strategy, establishes the municipal objectives in this regard, which are focussed on reducing waste generation, increasing the quality and quantity of selective waste collection, above all organic matter, and making city residents jointly responsible for proper waste management.

8.2.1 Stable waste generation

After a period in which waste generation fell dramatically, coinciding with the start and deepening of the financial crisis, successive increases have been recorded since 2013, reaching 799,981 tonnes in 2018, an amount similar to that recorded at the turn of the century. However, generation per person is somewhat lower and, despite increasing since 2013, levelled of at around 1.30 kg/inhab./day (1.36 kg in 2018). In spite of that, the volume is still above the targets set in both the Municipal Plan (1.27 kg per day/per capita in 2018) and the "Zero Waste" strategy (1.2 kg per day/per capita).

In 2017, the actions set out in the Municipal Plan have made it possible to prevent the generation of 2,531,53 tonnes of waste, mainly clothing collected for reuse. Although this is a modest figure when compared to the total waste generated, it demonstrates that prevention is a tool that still has huge potential for development in the case of most waste fractions.





8.2.2 Different selective waste collection methods for a diverse and dynamic city

Barcelona is a diverse city, both in terms of its uses and its urban fabric. These conditioning factors pose a challenge to the waste collection service, which must adapt to each neighbourhood to ensure that selective waste collection is effective and efficient. The different types of collection and the flexibility of the service must facilitate this.

→ **Domestic** ⊕. This corresponds to the collection of waste generated by households and businesses and activities not included under commercial collection. For the most part, waste is deposited in organic matter, glass, light packaging, paper/cardboard and general rubbish containers. In 2017, door-to-door selective waste collection began in the old quarter of Sarrià district, with very positive results.

→ **Commercial** ⊕. This is waste generated by businesses classed under commercial collection, such as shopping centres, key economic centres and industries with waste similar to the waste generated under this category. Commercial waste collection circuits collect organic matter, glass, paper/cardboard and general rubbish.

→ **Markets.** The 40 municipal markets, with the exception of Mercabarna, and the other street markets and fairs have separate waste collection services for organic matter, paper/cardboard and the remaining fraction.

→ **Bulky (furniture and junk).** Households benefit from a free, street-side bulk waste collection service, which is provided on a specific day of the week in each zone. A household collection service is also available in exchange for a public fee.

→ **Other collections.** Waste in the city's public parks and gardens is divided into organic matter and other waste. At Mercabarna, in addition to organic matter and general rubbish, paper/cardboard is collected. Dead animals are also collected (for the most part by social organisations).

In addition to these types of waste collection, the City Council offers residents different services to separate less frequent waste that is valuable or harmful and that must not be deposited with other waste. In addition, recycling spaces are also made available for specific items to prevent them from being disposed of as waste by allowing them to be reused:

→ **Green points** ⊕. Waste that cannot be deposited in selective waste collection containers is collected separately, mitigating the harm that certain waste can cause and increasing recycling figures. Green points are also responsible for separating objects that are in good condition, to prepare them for reuse.

- **Zonal green points (PVZ).** These are large-scale environmental facilities located on the outskirts of the city. Although the service is free for individuals, it is particularly aimed at the commercial and services sector. The city has seven zonal green points.

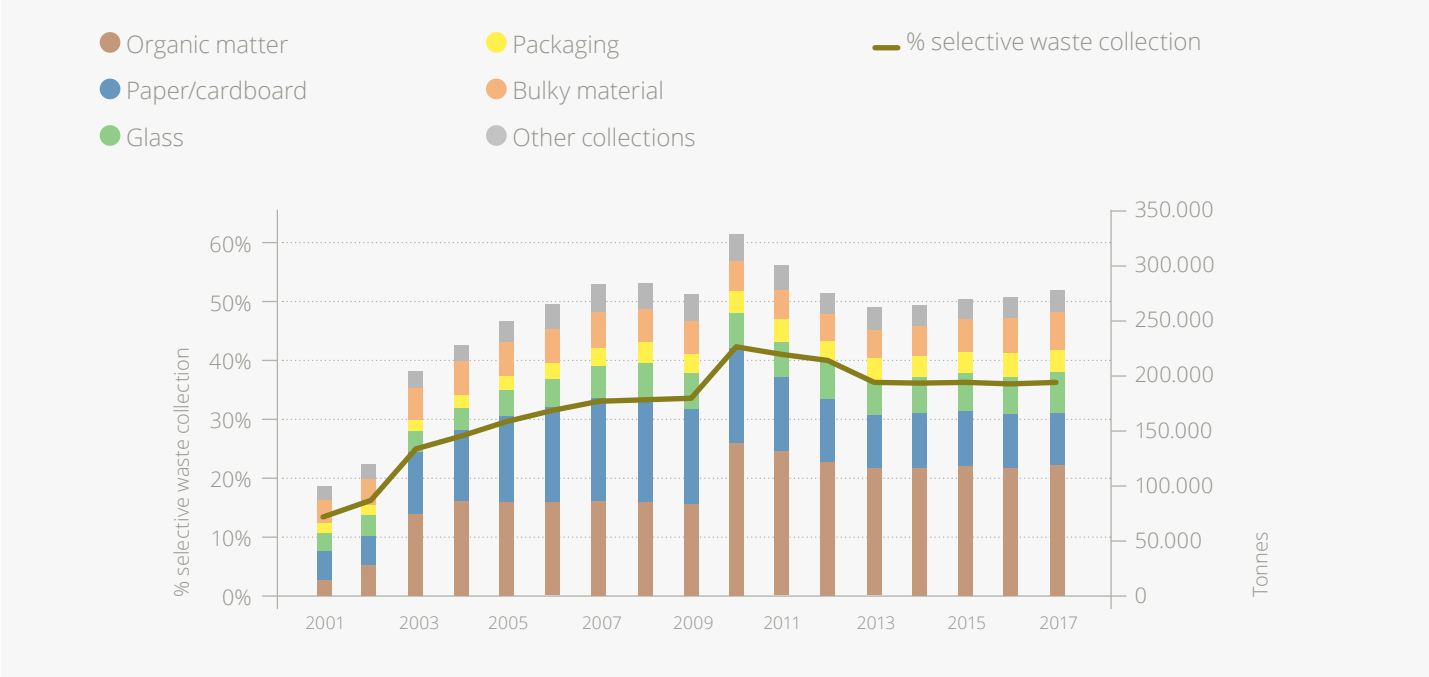
- **Neighbourhood green points (PVB).** These facilities are smaller in size and located within the urban fabric. They are designed for smaller, domestic waste. There are currently 25 PVBs.

- **Mobile green points (PVM).** These trucks perform all the functions of a green point. They stop at different places in the city at particular times, so they are closer to the public. There are 96 PVM vehicle stops.

In recent years, Barcelona has introduced improvements to municipal waste collection and management services, which have made selective waste collection progressively easier to access and enhanced awareness, meaning that reuse is gradually becoming a more prominent option. In addition, the awareness raising campaigns rolled out have been reflected in greater participation by the general public and the creation of a favourable social context. This is a process that is only possible thanks to the collaboration of hundreds of institutions, entities and companies across the city.

8.2.3 Stagnation in source separation habits

Since the deployment of the first organic containers and commercial collection in 2001, and their subsequent growth, selective waste collection has progressively expanded. The peak in gross selective waste collection came in 2010 and 2012, coinciding with the culmination of the implementation of organic material collection across the city and the expansion of the network



of green points. Nonetheless, over the past five years, source separation has decreased slightly compared to the record set in 2010, spurred by a reduction in the collection of organic matter and paper and cardboard, plateauing at around 36% (37.7% in 2018). Despite this, the percentage recorded is still well above the preceding period. This scenario reflects the consolidation of recycling habits but, at the same time, stagnation that must be rectified if we are to achieve current targets.

Alongside waste collection using containers, commercial collections and other selective waste collection systems in place across the city, the network of green points has continued to grow both in number of facilities and number of visits and waste deposited.

8.2.4 Everything has its place: the best destination for each type of waste

The environmental impact of waste aside, the impacts of collecting and subsequently handling these materials must be considered. Waste prevention is more effective in reducing these negative impacts to a minimum (such as the emissions associated with the energy consumption required for their collection and treatment, occupancy of space and the impact on the landscape of containers or treatment facilities). The lower the amount of waste, the more options there are for optimising collection routes and obtaining greater returns from the materials recovered. The proper management of waste collected depends largely on correct separation at source.

The main management methods that can be applied to municipal waste are as follows:

- **Preparation for reuse**. Green points across the city specialise in preparing domestic appliances, computers, mobile phones, furniture, clothing and books for reuse, among other items. This task consists of the selection and preliminary preparation of items so that they can continue to serve the purpose they were designed for in safe conditions for the future user. Thus, items in good condition are dedicated to social programmes and second-hand initiatives organised by social organisations, whilst those that cannot be reused are set aside for recycling.

- **Material recovery**. Waste can be transformed again into material to manufacture new products. Material recovery includes recycling materials that form part of organic matter, glass, paper/cardboard, light packaging, bulk materials, green point waste and other specific collections.

- **Mechanical and biological treatment**. This is a basic procedure applied to other material, based on the mechanical separation of recoverable material and the stabilisation of the biodegradability of the organic matter present in this fraction and the flows of waste from other management channels.

- **Energy recovery**. Applicable to waste with energy content, whether directly from other materials or the flows of waste from other management channels.

- **Controlled disposal**. This entails the disposal of solid waste at controlled landfills. In the case of Barcelona, all waste sent to these landfills is first subject to mechanical and biological treatment.

Taking these management channels into account, below is a brief description of the destinations of the main types of municipal waste in Barcelona.

- There are two possible ways of treating **organic matter**: composting or methanisation. The first, is used to produce compost, an organic, high-quality fertiliser; whilst the second generates methane to generate energy. Through the ordinary collection circuits, the City Council is promoting composting in neighbourhoods by installing community compost bins at some green points. In addition, a large number of schools transform their organic waste into compost to fertilise their school allotments and the Parks and Gardens service also follows this procedure for urban allotments, with each plot having its own small compost bin.

→ **Packaging** is selected at selection plants based on the type of material and from there, they are sent to recovery units.

→ **Paper/cardboard** that is collected from containers and as part of commercial collections is sent to authorised recovery units, where they are converted into large bales of shredder paper then used to manufacture items.

→ **Glass** collected on a selective basis is sent to recycling plants, where it is cleaned, unnecessary materials are removed and it is ground into glass dust, which is then used to manufacture new objects.

→ **Bulk materials** collected as part of municipal collections and from green points are sent to the wood and bulk management plant in Gavà, where they are shredded to make agglomerated tiles or allocated to the generation of energy.

→ **Waste from electrical or electronic devices** is collected from green points or distributors themselves. If they are not fit for reuse, this waste is treated at specialist centres to eliminate any harmful substance and recover as much recoverable material as possible.

→ **Other material** is processed at ecoparks, where, before being sent to controlled landfills or the energy recovery plant, it is subject to mechanical and biological treatment to recover as much material as possible and stabilise organic content to reduce methane and leachate emissions.

8.3 Measures implemented to reduce waste generation and improve selective waste collection

Barcelona is working to reduce waste generation and increase and improve the selective collection of waste that could not be avoided. The actions implemented over the past year have an impact on improving management and communication and the joint responsibility of residents.

8.3.1 New strategic tools to boost the 2012-2020 Municipal Waste Prevention Plan

"Zero Waste" strategy, the path towards excellence ⊕

The "Zero Waste" strategy approved by Barcelona City Council in 2016 is structured around prevention of waste at source, reuse, improving selective waste collection (in particular organic matter) and the joint responsibility of residents. This strategy is in line with the 2012-2020 Municipal Waste Prevention Plan and goes one step further by establishing even more ambitious targets:

- → Reducing the generation of waste to below 1.20 kg/inhab./day.
- → Achieving the figure of 60% recycling of urban waste.
- → Achieving the collection of a high-quality organic matter, with a maximum improper waste content of 8% by weight.

The *zero waste* philosophy is about reducing the generation of waste until everything is reintroduced into the production cycle or natural systems. It involves focusing on the circular economy, whereby the entire life cycle of products is envisaged, from design to use and recovery, and they are considered resources that can be reharnessed at all times.

The "Zero Waste" strategy includes 49 actions as part of nine areas of action. Some are already in operation, such as the clothing and toy exchange networks, repair workshops, community compositing, the "Where does my waste go?" exhibition or ecological purchasing and making municipal facilities greener.

From disposable cups to reusable cups

Single use items are a significant source of waste and drinks cups are a prime example of this. Consequently, the use of reusable cups at establishments and events in the city has progressively increased in recent years. The system involves users paying a one euro deposit, which is refunded when they return their cup. The deposit system, with no end cost to the public, enhances the value of cups whilst preventing neglect. It was first used at community celebrations, like those in Gràcia and Sants, at la Mercè festivities and facilities managed by Barcelona Serveis Municipals, such as Tibidabo, the Zoo, the Olympic Ring and Parc del Fòrum.

Since 2018, this system has also been used at beach bars, which represent key spaces in terms of raising awareness of marine litter and preventing the generation of this type of pollution.

At the beach bars and main festivities in the city (Mercè, Gràcia, Sants, etc.), in 2018, approximately 225,000 reusable cups were used, representing savings of more than 500,000 single-use cups.

With a view to going even further and consolidating this practice, a study has been implemented for the use of reusable cups in bars and businesses. In addition, for races like the Cursa de Bombers, Cursa dels Nassos and Cursa de Sant Antoni, where cup reuse is not feasible, the Barcelona Sports Institute has promoted the replacement of water bottles with paper cups and work is continuing along this line to implement this initiative at other races.

Reusable tableware lending service

Public celebrations, festivals and events often use single-use plastic plates, cups and cutlery, which end up being thrown away as rubbish (in the grey containers) and are therefore not recycled. So, since 2017, the city's institutions have access to a new free reusable tableware lending service. This service is managed by social and occupational integration institutions and includes full tableware for up to 500 diners. Since this service was rolled out, approximately 50 lending services (up to 31 December 2018) have taken place and the reusable tableware has been used by almost 10,000 people.

Food is not thrown away, we find a use for it

There are two sides to food waste: it is a significant source of waste generation and drains natural resources, in addition to being an ethical shortcoming of today's consumption model. It is calculated that in Catalonia, 262,471 tonnes of food is wasted that could be used to feed more than 500,000 people a year. To overcome this problem and seek innovative solutions, Barcelona City Council has organised a number of initiatives or has participated in them:

- **"Remenja'mmm"**. This campaign, promoted by the organisations BCN Comparteix el Menjar and Pont Solidari, encompasses more than 30 restaurants across the city who offer diners the option of taking home whatever they've been unable to finish, whilst implementing strategies to prevent waste (planning orders, recipes that make best use of food, size options adapted to customer orders, etc.).

- **Meals that make use of food**. "Els Dinars de Sobrats" (Leftover Lunches) have been organised every year since 2012 in a different neighbourhood. These communal meals make good use of leftovers and show solidarity. They focus on how food is wasted by putting the leftover food generated by commercial establishments to good use.

- **"Ens ho mengem tot!"**. This "We eat it all" project, part of the '"More Sustainable Schools" programme, also plays a key role in terms of reducing food waste: education and promoting good eating habits. The sixth edition was held in the 2018-2019 academic year. Thirty schools with more than 12,000 students took part in 2016-2017.

'Renova' exchange networks, a new home for clothing and toys

"Renova la teva roba jove" (Get some new clothes, youngster) is a clothing exchange network for clothes that people don't wear any more but which are still in good condition. This promotes responsible consumption, waste prevention and sustainability. It takes place in spring and autumn coinciding with the seasonal change of wardrobe at different facilities and organisations across the city and anyone who wants to can take part. This campaign has a version that is specially aimed at the general public aged between 12 and 35, which is organised by youth organisations and facilities. Some spaces organise activities to encourage young people to participate, such as fab labs, where they can customise garments.

"Renova les teves joguines" (Get some new toys) is an initiative to promote conscious consumption and waste prevention that takes place in November and December,

offering an alternative to Christmas shopping, and also in May. It is mainly held at children's centres, playrooms and neighbourhood or civic centres. At fab labs, users can print toy parts that need to be repaired in 3D and free of charge.

Extending the life of domestic appliances via repair networks and workshops

Barcelona City council has launched a repair-workshop programme ⊕ at civic and neighbourhood centres. This programme is intended to provide people with the necessary knowledge for repairing their own PCs, mobiles, tablets etc., and small electrical appliances. Its aim is to prevent waste from electrical and electronic appliances in Barcelona being generated to save on raw materials in the production of new appliances, reducing waste generation and encouraging society in the "DIY" culture. The programme is supported by the "Millor que nou, 100% vell" ⊕ and "Reparat, millor que nou" ⊕ networks within the Barcelona Metropolitan Area.

In addition to this programme, in 2018, the first technology waste management centre was opened in Poblenou. This centre, located in an old Modernista industrial unit owned by the Council that has been refurbished for the purpose and is managed by the Trinijove Foundation, offers work to more than a dozen young people at risk of social exclusion who work in the fields of recycling and reuse of new technologies, with mobile phones, tablets and computers.

Repair-workshops programme.

8.3.2 Promoting selective waste collection

New cleaning and waste collection contract approved with social and environmental criteria

In 2018, the specifications for the tender of the future cleaning and waste collection contract ⊕ were approved. A service has been defined that adapts to the changing needs of a city like Barcelona, and which will be groundbreaking in terms of innovation, efficiency and management transparency. Amongst the environmental measures included, worth particular mention is the inclusion of zero-emission and electric vehicles (and the ban on diesel) as well as the harnessing of available alternative water resources, such as groundwater and more efficient flow reducing application systems.

Selective waste collection in the old quarter of Sarrià increases threefold thanks to joint responsibility

In February 2018, a pilot door-to-door selective waste collection test in the old quarter of Sarrià ⊕ was rolled out. Six months after it was implemented and following a lot of work to provide information and promote the new collection system amongst local residents, selective waste collection has tripled. The type of waste that has grown most is organic matter, the collection of which has increased by almost ten times (from 1.9% of the total to 24.5%) with impurity levels of just 2%. The collection of light packaging has increased from 5.1% to 13.2% and paper and cardboard from 6.4% to 9.5%. Although glass is still collected from containers, this has also increased, from 5.1% to 8.8%. Therefore, the general rubbish fraction has decreased considerably and selective waste collection is 18 per cent higher than the city average (increasing from 19% to 55.8%).

These excellent results have been made possible thanks to residents sharing responsibility for the scheme. Like all pioneering initiatives, it has not all been smooth sailing. Therefore, a committee has been established by the Neighbourhood Council, comprising residents, traders, institutions and the City Council, to permanently monitor the system and propose solutions to improve it.

Pilot door-to-door selective waste collection test in the old quarter of Sarrià.

Expansion of the green points network to provide a closer service

The network of green points ⊕ is an essential element in guaranteeing correct waste management as a whole. In order to provide a service that is closer to residents, the network has expanded the number of neighbourhood green points to a total of 25. The most recent to have been opened are the green points in Mercat del Ninot, Mercat de Sant Antoni and Sarrià, with further points to be opened in Vallcarca, Sants and Vall d'Hebron in the coming years.

Alencop, a pioneering project to enhance the dignity of scrap iron collection and promote its reuse

Alencop ⊕ is a social initiative cooperative created in 2015 that currently comprises 25 members from a dozen different sub-Saharan nationalities. The cooperative's work focuses on collecting scrap iron and unused electrical appliances from households for their reuse, as well as raising awareness about waste. The project was promoted by Barcelona City Council and receives its support and advice. After three years in operation, new lines of activity has been rolled out in 2018 ⊕, focussing on the management and reuse of waste, along with a second-hand shop. New facilities have also been acquired that will make it possible to progressively increase the territorial scope of action of the free household collection service offered.

8.3.3 From communication to action

Communication plan to improve the collection of organic matter in neighbourhoods ⊕

Between February and July 2017, a communication campaign was carried out in four neighbourhoods in the city as a pilot test to improve the collection of organic matter, both in terms of quantity and quality. Based on a preliminary study that took into account the neighbourhoods' features and organic matter collection rates, the neighbourhoods chosen for the pilot test were La Barceloneta, Les Roquetes, El Putxet i el Farró, and El Guinardó. These are four neighbourhoods with very different realities, as well as unequal results with regard organic waste collection.

As part of this campaign, carried out with the involvement of eight informers – two per neighbourhood – and two coordinators, a Guide to improve selective waste collection ⊕ has been created, in addition to neighbourhood green points being used as a reference for environmental education.

Awareness raising campaign to improve cleanliness in the city

The campaign, carried out in 2017 and 2018, has focussed on two lines of action. On the one hand, 256 critical points identified have been monitored in order to adapt the service and understand the causes of the lack of cleanliness. On the other hand, specific actions have been taken with residents, businesses and neighbourhood organisation to promote best practices in terms of pet ownership and hygiene, the usefulness of green points, separating organic matter and free street-side collection times for old furniture. In 2017, there were 100 information staff on the street and over the course of 2018 a team of 20 environmental information officers have visited 5,062 businesses and informed 33,784 people.

Compared to 2017, all indicators for residents' and business habits have improved, with 68% of critical points having improved their state of cleanliness.

Schools in the city work to prevent waste and improve waste management

Environmental education plays an essential role at schools in ensuring that care for the environment takes root, in a lasting way, amongst future generations. As part of the "More Sustainable Schools" programme, work is carried out on projects relating to waste prevention and correct waste management: the micro networks as part of the Waste Prevention Plan, "More Sustainable Wrappers", "Ens ho mengem tot!" and "Compostem i aprenem", programmes, in addition to customised advice offered to each school for their own projects.

8.3.4 Cleanliness: civility and respect for shared spaces

#CompartimBCN

In order to promote the correct use of public space for the well-being of residents, starting in the summer of 2018 a campaign was rolled out on cleanliness, beaches and coexistence in the city's neighbourhoods. The aim of this campaign, which uses the hashtag #CompartimBCN, has been to call on residents to assume joint responsibility; four illustrators are participating in this initiative, contributing different styles of art that express diversity and add great visuals to this long-term communicative action.

A new energy efficient cleaning work centre beneath Parc de Joan Miró

Cleaning work centres are basic facilities for managing road cleaning and serve as a base for the staff and material involved in all road cleaning tasks. In 2018, an open day was held at the new cleaning work centre beneath Parc de Joan Miró, which joins other underground centres in Horta and Sant Gervasi. The new facilities, however, are an example of energy efficiency and minimum consumption, in addition to boasting the highest levels of comfort. With a surface area spanning 3,556 m^2, it has the capacity for 300 operators and 60 service vehicles. The building uses geothermal energy, harnesses groundwater and purifies grey water for reuse; furthermore, to build the centre, debris from the square's old paving was used. Thus, this is a space that harnesses the resources in the surrounding area and minimises the impact on the landscape. The work centre has received recognition in the shape of four green leaves of the Green Building Council España (GBCe) environmental certificate.

8.4 Future goals and measures

The coming years will be marked by urgent and necessary legal changes at all levels to promote waste prevention and high-quality selective waste collection. New formulas are required to reduce waste and radically increase selective waste collection on all fronts: tax incentives, waste generation charges, the implementation of new systems, such as deposit, return and refund systems, the expansion of joint responsibility to producers of more types of waste or a ban on different single-use plastic products, are an example of the changes yet to come.

Through both the Municipal waste prevention plan 2012-2020 and the "Zero Waste" strategies, Barcelona City Council is proposing new actions to continue making progress towards a more efficient and rational use of resources, on the basis of waste prevention and by means of the circular economy, with reuse and recycling as the cornerstones of these policies.

8.4.1 Progress towards zero waste

New cleaning and waste collection service

The new cleaning and waste collection contract will be a key component in putting the "Zero Waste" strategy into practice. The improvements achieved as part of this new service will be as follows:

- **Waste collection and cleaning adapted to each neighbourhood.** The new contract is more flexible and adapted to the different uses of public spaces and to climate change.

- **New selective waste collection systems.** Based on the experience of the door-to-door waste collection pilot project in Sarrià, the new contract provides for the option of introducing or amending waste collection systems, in particular, the extension of the door-to-door system to other parts of the city. In addition, other recyclable plastic and metal waste may be deposited in yellow containers as well as light packaging.

- **More commercial collection of organic matter.** Door-to-door commercial collections will be extended to 1,000 establishments that generate organic matter and that currently use collective street-side containers.

- **Cleaner and quieter vehicles.** Priority will be given to the fleet of zero-emission vehicles to reduce noise and improve air quality. A positive outcome of this will be to reduce the fleet's emissions, based on the fact that light vehicles must be electric and refuse collection vehicles must not be diesel.

- **Greater control and more transparent management.** Waste collection and cleaning devices will be fitted with new technology to provide information on their use and improve their efficiency and effectiveness. Furthermore, in the medium term, systems will be rolled out to promote waste prevention and recycling amongst residents, such as waste generation charge systems through the identification of users. These technologies will also make it possible to enhance public control over the service and provide residents with information as a new way of the public taking control of contracts.

Implementation of actions as part of the "Zero Waste" strategy

In recent years, the "Zero Waste" strategy has become a catalyst for all waste prevention and management actions in the city. Besides the actions already implemented, the strategy provides for other projects that are currently being studied or evaluated. A large part of these projects have been included in drawing the new cleaning contract, whilst others will be rolled out progressively, such as the creation of a zero waste observatory or the implementation of more deposit, return and refund system systems.

A city council with less plastic waste

Based on the technical specifications for the procurement of food and events services, and the new European directive on single-use plastic, the City Council is in the process of drawing up instructions to prevent the use of single-use cups, tableware, bottles and other plastic items at municipal offices and services, in addition to the distribution of bottled water. The instructions establish that, all municipal offices and services, must prevent the use of bottled water and single-use plastic cups and includes a series of new recommendations to promote the consumption of tap water.

8.4.2 Green points 2.0: reinventing green points

Spaces promoting transparency and environmental education

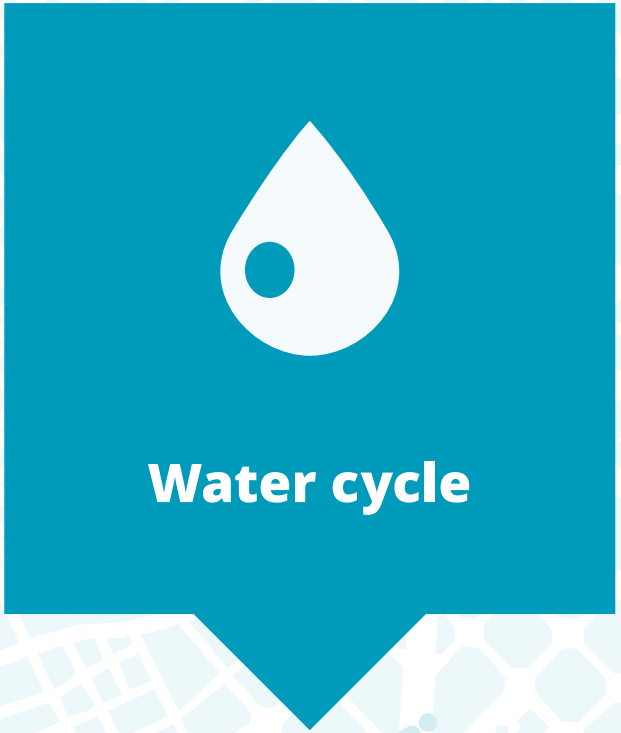
The city's green points are home to digital devices that disseminate environmental information and activities in the city, informing users about the destination of the waste collected and the way in which selective waste collection works. Using these elements, and with support from workers at these facilities, the aim is for green points to become benchmarks in terms of environmental education and communication in the city's neighbourhoods. The role of green points as reuse centres both at the facilities and through spaces and entities, such as the fab labs, will continue and be reinforced.

Communal compost points

In order to increase the quantity and quality of the selective waste collection of organic matter, certain green points may become spaces where this type of waste is also managed. They will do so through communal compost projects, as is the case at the green points in La Barceloneta, Sagrada Família, Folch i Torres and Fort Pienc. There are other compost bins in Porta and Coll-Vallcarca (Bosc Turull).

8.4.3 New cleaning work centres

In line with the objective of creating a cleaning work centre per district, as a minimum, new centres are due to be set up in Gràcia, Eixample and Sants-Montjuïc. These centres will respond to the cleaning needs of these districts with minimum disruption to residents and ensuring their integration in the landscape, in the urban fabric and energy efficiency.



Water cycle

Barcelona makes progress towards sustainable water management

Water cycle

Vision of the future

Ensure the availability and sustainable management of water and sanitation for all and protect water as a highly valuable resource

Current situation

Water consumption

2013
94.67 hm³
of total drinking water

2017
96.14 hm³
of total drinking water

66.19 % domestic

27.76 % trade and industry

6.05 % municipal services

2013
108.42
l/inhab./day
of domestic water

2017
108.26
l/inhab./day
of domestic water

Sustainability Index for the leveraging of alternative water resources by municipal services
(groundwater consumption/ total water consumption)

2013
19.95 %
2017
18.25 %

Sanitation

100 %
purified
water

EDAR del Besòs
65 %
EDAR del Baix Llobregat
35 %

Lines of action

Savings and efficiency "Leveraging of alternative water resources" "Savings in greenery management" "Cleaning and drainage"

Awareness raising "Promotion of water savings" "Activities and disseminated materials"

Quality and sanitation "Improving the quality of drinking water" "Sanitation Master Plan"

Flood management "Sustainable urban drainage systems" "Network of retention tanks"

9.1 Vision, challenges and opportunities

Vision of the future

Barcelona protects water as a highly valuable and indispensable resource. Therefore, the city's priority is to reduce the consumption of drinking water, close the water cycle, optimise the use of groundwater, promote the use of rainwater, regenerated water and grey water, and facilitate water infiltration into the subsoil. To achieve that requires integrated management of the water cycle, which encompasses supply, drinking fountains, lakes and decorative fountains; drainage of the city through drainage systems, rainwater retention tanks and sustainable urban drainage systems (SUDS), and integrated management of the coast and beaches.

Barcelona, like any other city in the world, intervenes in the natural water cycle, both in terms of demand for drinking water and the disposal of wastewater. The concentration of residents and economic activities generates a need for drinking water that cannot be covered with the water resources available in the surrounding area (end of the Llobregat and Besòs basins), meaning that it must look for water further afield and construct infrastructures and transport networks. Consequently, it is necessary to employ planning and management strategies and policies that, in accordance with sustainability principles, help to save water and use it responsibly, and make efficient use of all water resources available.

- **As a Mediterranean city, water management in Barcelona is a very complex issue.** In Mediterranean areas, like Barcelona, water resources are precious, due to irregular rainfall and occasional periods of drought. Furthermore, there is a flood risk caused by torrential rain and the high level of impermeability in the city.
- **One of the main impacts expected of climate change is the impact on the water cycle.** A slight decrease in water resources is predicted, in addition to greater variability in its availability, with an increase both in droughts and floods, as well as an increase in demand. This will aggravate the deficit in the supply that the city is already suffering today.
- **Without taking desalination plants into account, the city's water supply system is deficient.** Resources are either lower than or very close to existing demand one out of every fours years. This fact is currently resolved thanks to reserves accumulated in previous years, but supply can only be guaranteed for one year.
- **Alternative water resources are key in guaranteeing future demand.** In the context of climate change, it will be essential to replace the use of drinking water with alternative water resources (groundwater, regenerated water, grey water, rainwater and seawater) in areas in which the quality of drinking water is not required.
- **Barcelona, a city aware of the need of savings and the efficient use of water resources.** Barcelona's commitment has resulted in the implementation of a number of measures aimed at reducing water consumption, actions that have been especially significant in municipal services and facilities. However, the role of residents in this process needs to be stressed, as overall and personal consumption has decreased significantly.

9.2 General context and current situation

Barcelona suffers from recurring episodes of drought that are turning potable or drinking water into a very valuable resource and putting our capacity to maintain the city's water supply at risk. Moreover, the city has a very high degree of impermeability (72% of the municipal total). Hence, Barcelona City Council spares no efforts in managing water resources in an integrated manner and to close the water cycle.

Responsibility for water management in Barcelona is shared between different bodies. Generally speaking, responsibility for the supply of wholesale water lies with the regional administration, through the Catalan Water Agency, whilst the Barcelona Metropolitan Area is responsible for distribution to users.

The City Council therefore has no direct responsibility for the supply of drinking water, although it oversees water management in general or, in the event of a drought, promotes the actions required to reduce excessive municipal consumption and organises awareness-raising campaigns. Together with the regional government, the Generalitat of Catalonia, the City Council also acts as a health authority that monitors the quality of piped water through the Barcelona Public Health Agency.

The City Council is also responsible for planning and

Competences of the administrations in the field of the water cycle in the city of Barcelona

	Catalan Government	Barcelona Metropolitan Area (AMB)	Barcelona City Council
Water planning	●		
Wholesale supply	●		
Retail supply		●	●*
Leveraging concessions	●		**
Management of alternative water resources (municipal uses)		● ***	●
Monitoring and inspection	●	●	●
Tariff approval	●	●	
Rainwater management		●	●
Sewerage system		●	●
Wholesale sanitation		●	
Actions in risk of drought	●	●	●
Coastline management	●	●	●

* *Barcelona City Council delegates this responsibility to the AMB.*

** *Barcelona City Council has a concession to leverage underground water for the supply of municipal uses where permitted.*

*** *The AMB manages the production and distribution of regenerated water from Llobregat treatment plant (EDAR).*

managing the city's alternative water resources through the public municipal water company, Barcelona Cicle de l'Aigua, SA (BCASA).

BCASA is committed to ensuring the sustainable management of water in Barcelona, as well as optimal sanitation conditions for the urban cycle. It also supports the City Council in terms of improving solidarity in access to water, with initiatives relating to reduced consumption and the promotion of responsible consumption in every sector.

9.2.1 Different water resources to satisfy demand

The sources of the city's water supply mostly come from surface water, although in recent years there has been a significant increase in groundwater.

Surface resources used for human supplies come from the Ter and Llobregat rivers. Water from the Llobregat is controlled by the La Baells, La Llosa del Cavall and Sant Ponç reservoirs and purified at the Sant Joan Despí and Abrera plants before being introduced into the water supply. In turn, water from the Ter is obtained via the Sau-Susqueda-El Pasteral reservoir network, which is treated at the Sant Joan Despí drinking-water treatment plant. The two networks are interconnected to form the Ter-Llobregat system, in order to ensure the distribution and final quality of the water. The water supply from these resources is managed jointly throughout the metropolitan area. It needs to be borne in mind that there is currently a deficit of drinking water in the inland basins.

Since 2009, the Prat de Llobregat desalination planthas been ready to ensure and complement the demand for drinking water in exceptional circumstances. It enables the introduction of 60 hm^3/year.

Underground resources, which are used for non-drinking purposes, are taken from the aquifers of the Llobregat and Besòs deltas, as well as the Barcelona Plain. The gradual abandonment of industrial wells has meant that the water table has gradually risen. In some places it has almost returned to its natural levels, which has led to problems in basements, car parks and public services, such as the metro system. This large volume of water has become a source of water resources for municipal uses. Currently, the leveraging of groundwater comes to around 1.3 hm^3 per year and, based on technical and economic criteria, the leveraging threshold is 4.4 hm^3/year (concession volume).

As regards the water reuse potential, Barcelona has three wastewater purification stations (EDAR), although only the Prat del Llobregat EDAR applies tertiary treatment (since 2008) and is able to offer regenerated water. The potential outflow of regenerated water from the EDAR is 3.25 m^3/s, although under normal circumstances, the plant works at 10% of its capacity. The compatible uses of regenerated water include seawater intrusion barrier, maintenance of the river's environmental flow, agricultural irrigation, maintenance of wetlands, industrial use, street cleaning, sewage systems, irrigation of green areas and toilet flushing, among others.

The leveraging of grey water in new buildings and facilities can contributes to the reduction in drinking water consumption and offers a high water, energy and resource saving potential, as it is a nearby water resource. Grey water is obtained by leveraging shower and bath water and when swimming pools are emptied. Once treated, it can be used for toilet flushing, sprinkler irrigation, cleaning, and so on. The leveraging of grey water offers water saving potential of 30% of the drinking water used in the domestic sector.

Rainwater represents an essential contribution to irrigate green spaces and supply the water table, despite the irregular nature of the Mediterranean rain system. Therefore, its contribution varies from one year to the next. For example, whilst in 2013 it accounted for 55% of all irrigation water (2.58 hm^3), in 2017 it accounted for 48% (2.39 hm^3).

Rainwater can be leveraged in terms of the roofs of buildings. Barcelona is currently trying to boost the collection and use of rainwater for urban services and public facilities (watering green areas, urban allotments, green walls and green roofs, filling ornamental fountains, cleaning streets, supplying fire stations); for residential use (fill-

ing toilet tanks and washing machines, watering gardens and private allotments, swimming pools, etc.), and for industrial use (cleaning vehicles and industrial areas, filling water tanks for firefighting purposes).

9.2.2 Decrease in the consumption of drinking water by municipal services thanks to the use of alternative resources

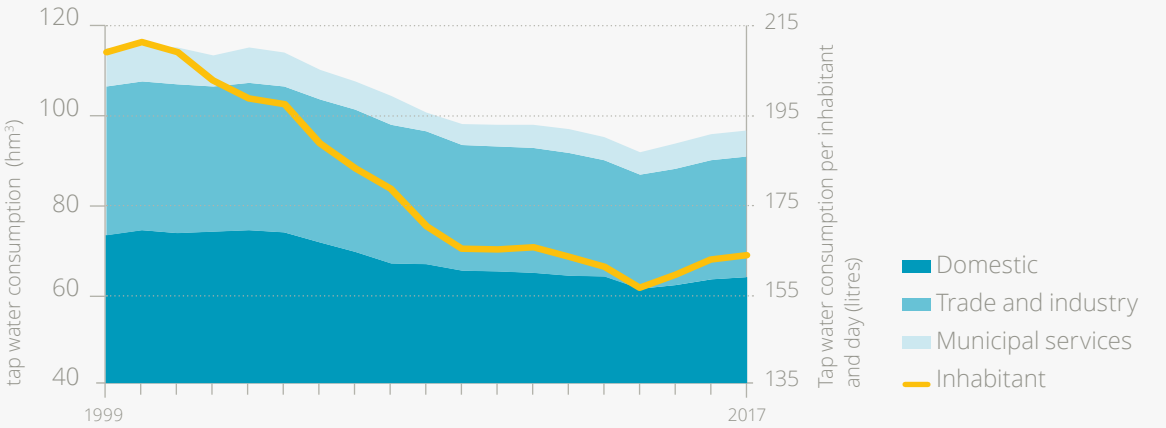
Total tap water consumption in Barcelona in 2017 came to 96.14 hm^3, 163.6 litres/person/day, in other words, 18.32 hm^3 less than in 1999. Although there has been a decrease in consumption in recent years, the figure has grown slightly since 2015.

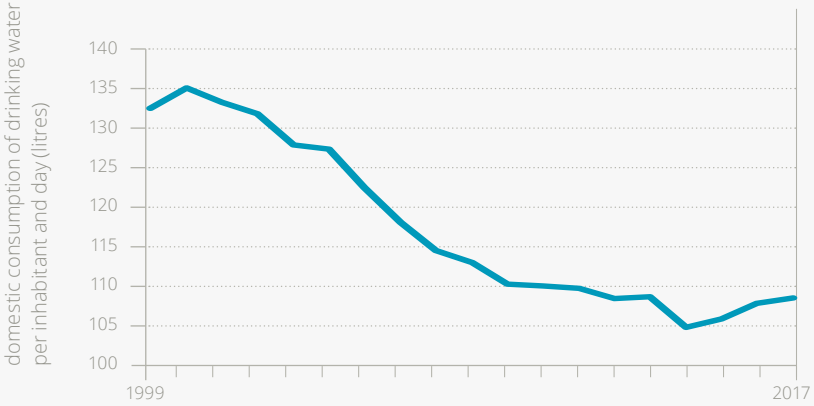
The domestic sector accounted for 66.19% of consumption (63.63 hm^3 year); trade and industry for 27.76% (26.69 hm^3), and municipal services for 6.05% (5.81 hm^3). There has been a reduction in tap water consumption of 12.75% in households and 19.21% in trade and industry since 1999.

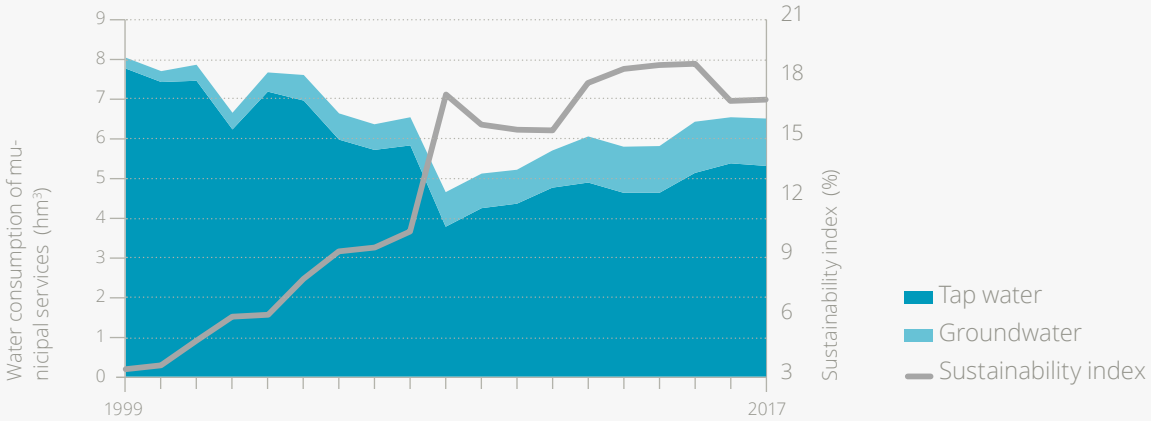
In the domestic sector, consumption per inhabitant and day followed the same trend as overall consumption and came to 108.26 litres in 2017, in other words, 24.64 litres less than in 1999.

Consumption of tap water by municipal services came to 5.81 hm^3, 2.68 hm^3 less than in 1999, in other words, down by 31.53%. Between 2007 and 2008, the decrease was more than 51% due to the drought decree. This sector has seen the greatest reduction, due to more efficient use of water and the use of alternative water resources, mainly underground water.

Total consumption by municipal services in 2017 (drinking water plus groundwater) came to 7.11 hm^3, 1.68 hm^3 less than in 1999, in other words, down by 19.12%. The consumption of groundwater compared to total consumption represents 18.3% (1.30 hm^3), a 4.3 times increase on 1999 (from 301,730 to 1,298,026 m^3). Barcelona City Council uses groundwater for watering parks and gardens (38.02% of the total in 2017), street cleaning (23.23%), ornamental fountains (26.75%), sew-







er cleaning (8.99%) and other uses, such as sports facilities and supplying fire stations (3.01%).

The increase in groundwater consumption by municipal services and the reduction in demand for tap water has resulted in a significant increase in the sustainability index, considered as the proportion of groundwater consumed compared to total water consumed (groundwater plus drinking water).

In 2017, this ratio came to 18.25%, while in 1999 it came to 3.43%. Recently, this has been affected as control of consumption and the efficiency of most water depths supplied with groundwater has improved, which has resulted in water savings. On the other hand, in 2017 the consumption of drinking water by other municipal services decreased, as was the case of municipal markets, the zoo and other buildings. As a result, the aim will be to continue increasing this ratio following the trend set in recent years.

9.2.3 Treatment of 100% of wastewater in Barcelona

The urban sanitation of wastewater includes the collection, evacuation, treatment and control of wastewater through a sewerage system, purifiers and other secondary facilities.

The city's sanitation system starts at points of use, whether domestic, commercial, industrial or municipal. The sewerage system collects wastewater through drains and rainwater through sinks and flood collection points in the Collserola region. Barcelona has a unitary sewerage system: in other words, both wastewater and rainwater is transported through the same pipes. The sewerage system sends water to wastewater collector-interceptor pipes which take it to the EDARs to be treated. When it rains and these pipes reach their maximum capacity, urban drainage water may be diverted directly to the receiving environment.

The sewerage system is 1,874 km in length, of which 1,576 km are owned by the City Council, serving 1.6 million residents and the commercial and industrial establishments located in more than 81,500 premises within the city's 100 km^2 surface area.

The two most important purifiers that treat water in Barcelona are the Besòs EDAR (65%) and the Baix Llobregat EDAR (35%). The Vallvidrera EDAR, which is much smaller, exclusively serves property developments in the area.

Once water is purified and the quality conditions set out in the Water Framework Directive are met, it is introduced into the system again, where it may be collected (depending on its location) or regenerated (with additional, more intensive treatment than performed during purification) for reuse. In that way it is possible to use this water for a second time before discharging it.

9.2.4 Need for additional drinking water in Barcelona

In the Mediterranean environment, one of the most important effects expected of climate change is the impact on the water cycle and the consequences that this may have on the management of the entire water cycle at a territorial level and in particular in urban environments.

In the annual water cycle balance, water introduced into the cycle is estimated at 200 hm^3, of which 60% corresponds to tap water (surface water from the Ter-Llobregat, underground water from the Llobregat and Besòs wells, and desalinated water), with 30% coming from rainwater and 10% corresponding to underground water that cannot be used as drinking water.

The supply system faces a threat in the event of a drought. Droughts occur cyclically and there are circumstances in which resources are close to or lower than demand. Supply using reserves from reservoirs can only be guaranteed for a year.

The expected effects of climate change on the water cycle are a slight decrease in water resources, a larger variation in its availability and an increase in demand. More specifically, a 12% reduction in surface resources and 9% in underground resources is forecast by 2050, along with a 4% increase in demand for different uses. There will therefore be a general need for additional potable water resources in the metropolitan area of 34 hm^3 a year, with Barcelona's need estimated at 18 hm^3 a year.

Furthermore, it is also expected that climate change will result in rising sea levels and a change in the rain system, with an increase in the intensity of rainfall and a concentration of extreme events, causing an increase in the risk of flooding, morphological changes to beaches and greater exposure of port infrastructures *(see Chapter 2 "Resilience and adaptation to climate change")*.

9.3 Measures implemented to decrease water consumption

In recent years, the City Council has promoted a wide range of measures that have made it possible to reduce the consumption of drinking water, in particular by municipal services, guaranteeing supply in the event of a drought and reducing the risk of urban flooding and the impact of diversions to the receiving environment.

9.3.1 Savings and efficiency to guarantee the water supply

Reducing municipal consumption

→ **Reducing consumption in buildings and municipal facilities.** The City Council has implemented a range of initiatives to progressively reduce water consumption, such as replacing inefficient systems with water saving devices, the installation of waterless urinals or the roll-out of awareness-raising campaigns amongst municipal workers, as part of the "More Sustainable City Council" programme.

→ **Saving water at schools.** As part of the "More Sustainable Schools" programme, schools are provided with teaching equipment relating to saving water and they are encouraged to implement water saving and efficient use measures.

→ **Saving water at public fountains.** The 1,688 drinking fountains in the city are fitted with timed taps and flow regulating devices.

→ **Efficient management of green spaces.** Thanks to smart remote irrigation management, water consumption in parks and gardens across the city has dropped by 25%. This system, implemented in 2013, is based on adapting irrigation to plant types and the theoretical needs of each green surface, on the quantification of useful rainfall, the control of actual water that reaches the plant and a faster leak detection capacity. The use of groundwater for irrigation and the selection of plant species that need less water also needs to be taken into account. The Greenery and Biodiversity Plan, the Stimulus Programme for the City's Urban Green Infrastructure and the Tree Master Plan are based on sustainable water management.

Of the 493 ha of irrigated green space, 302 ha are currently irrigated automatically.

Raising awareness among residents to promote saving water

The City Council has taken a wide range of actions to raise awareness among residents about saving water and responsible use, in addition to increasing knowledge of the most important municipal actions to this end.

The "More Sustainable Barcelona" programme has created promotional material and performed a wide range of activities, including "Com funciona Barcelona. El cicle de l'aigua a la ciutat", for adults and school children; the publication of informational material such as *L'Espai de Mar* or *L'aigua i la ciutat*; the creation of resources with the Fonts de Barcelona mobile application or the "More Sustainable Barcelona" map; the presentation of exhibitions or the City Council's adhesion to World Water Day, as part of which a range of actions were taken.

On the other hand, the "Water Brief" programme seeks to place an emphasis on water heritage, in addition to

talks, meetings and seminars, including tours of the sewerage system and rainwater tanks across the city, tours taking in wells, fountains and springs, and visits to landmarks including the Rec Comtal and the tunnel connecting Casa de l'Aigua in Trinitat Vella to Casa de l'Aigua in Trinitat Nova.

Minimising losses in distribution

Some of the measures rolled out to reduce losses in the distribution of drinking water include sectioning, renovating and repairing the distribution network, installing high precision electric meters to detect leaks, informing users of them and correcting them more quickly.

Drought Protocol (2018)

In compliance with the Special Action Plan in the event of alerts and potential droughts (PES) created by the Catalan Water Agency, the City Council has drawn up a Drought Protocol (2018), to replace the Municipal Action Plan in the event of drought. The protocol sets out all the actions that municipal services and external services must take in the event of a drought, taking into consideration not only the measures provided for in the regulations in force, but also preventive and proactive extraordinary measures for more efficient water management of water and to raise public awareness.

Improving system redundancy

This is based on drawing up contingency plans for different pressure levels to guarantee supply and ensure the performance of connection work to upstream tanks in the Llobregat-Besòs basins. That enables the water supply to be guaranteed in the event of an incident in any of the supply networks.

9.3.2 Harnessing alternative water resources

Technical Plan for Using Alternative Water Resources (2017-2022)

This Plan, drawn up in 1998 and updated in 2009, 2013 and 2017, seeks to decrease the consumption of drinking water in the city. The 2017 edition added new lines of action to promote alternative nearby resources, in addition to further harnessing underground water addressed in previous plans. The lines of action included entail harnessing regenerated water, grey water, rainwater from the roofs of buildings, rainwater from the headwaters of Serra de Collserola, the inclusion of sustainable urban drainage systems in public spaces and directly harnessing seawater.

It identifies available water resources, analyses the uses and needs they can satisfy based on their chemical and biological characteristics, sizes up potential demand and establishes the infrastructures required to harness them.

The measures implemented over the years have given rise to a significant reduction in the consumption of drinking water by the Environment and Urban Services municipal services.

Use of groundwater for irrigating green areas

The irrigation of green spaces represents one of the main consumptions of groundwater in Barcelona, amounting to 503,589 m^3 in 2017. The sustainability index for green spaces in 2017 came to 19.08%.

Use of groundwater for urban cleaning and cleaning the sewerage system

In recent years, the consumption of tap water to clean the streets and the sewerage system has reduced thanks to the harnessing of groundwater. In 2017, 79% of street cleaning and 99% of sewerage cleaning was performed using groundwater.

Alternative water resources for ornamental fountains and ponds

Ornamental fountains and ponds, and other water features across the city, prioritise the use of underground water over drinking water. In addition, they are equipped with recirculation systems and have physico-chemical or biological treatment systems to maintain the quality of the water needed.

9.3.3 Quality of drinking water guaranteed and improved

Improving the quality of drinking water

The technological improvements introduced from 2009 onwards at water treatment plants in the Llobregat basin (ultrafiltration and inverse osmosis membranes, as well as desalination by electrodialysis reversal) have made it possible to achieve a significant improvement in the organoleptic and physico-chemical quality of this water. These technological advances have helped to reduce the salinity of the water produced, improve its taste and its organoleptic properties in general, reduce its hardness and further increase its safety.

9.3.4 Wastewater treatment and the protection of basins and the coast

Barcelona Sanitation Master Plan (PDISBA)

The main objective of the Master Plan is to study the existing network, including the performance of surface run-off and its interaction with the sewerage system, as well as incorporating all the measures to make the city more resilient to rainfall, setting up strategies to protect underground bodies of water and the receiving medium (coastal waters, rivers, streams).

Municipal emergency action plan for the risk of accidental pollution of marine waters

This emergency plan seeks to provide a response to any accident that results in the pollution of urban coastal waters, either because of direct discharge from the sewerage system or a spill from a ship or coastal industry. The likelihood of sanitation system discharges during strong rainfall is significant, so actions needs to be established to guarantee the quality of bathing water.

Besòs Agenda (in preparation)

The Besòs Agenda seeks to define a joint action strategy based on consensus between the five municipalities that make up the Besòs area, in order to highlight the potential of this region and face the current social, economic, environmental and urban planning challenges, in cooperation with institutions and associations in the area. The Agenda sets out the future horizon of the area and proposes a roadmap for getting there, based on a participatory process involving all the players.

9.3.5 Run-off management and flood risk

Flood management with the network of rainwater retention tanks

To overcome the flood risk to which the city is exposed, the City Council has developed a strong network of rainwater collectors and retention tanks located at strategic points: 15 rainwater retention tanks, of which 12 serve an anti-flood function, 1 serves an anti-unitary sewerage system discharge function and 2 are lamination basins or flood areas for extraordinary rainfall. These tanks serve a dual protection purpose:

→ To protect the city in the event of intense rainfall: they serve a peak discharge lamination function, retaining rainwater and preventing floods.

→ To protect the receiving environment: first rainwater, which has the highest pollutant load, is retained in the anti-unitary sewerage system discharge tanks and driven to the purifier.

Sustainable urban drainage systems (SUDS)

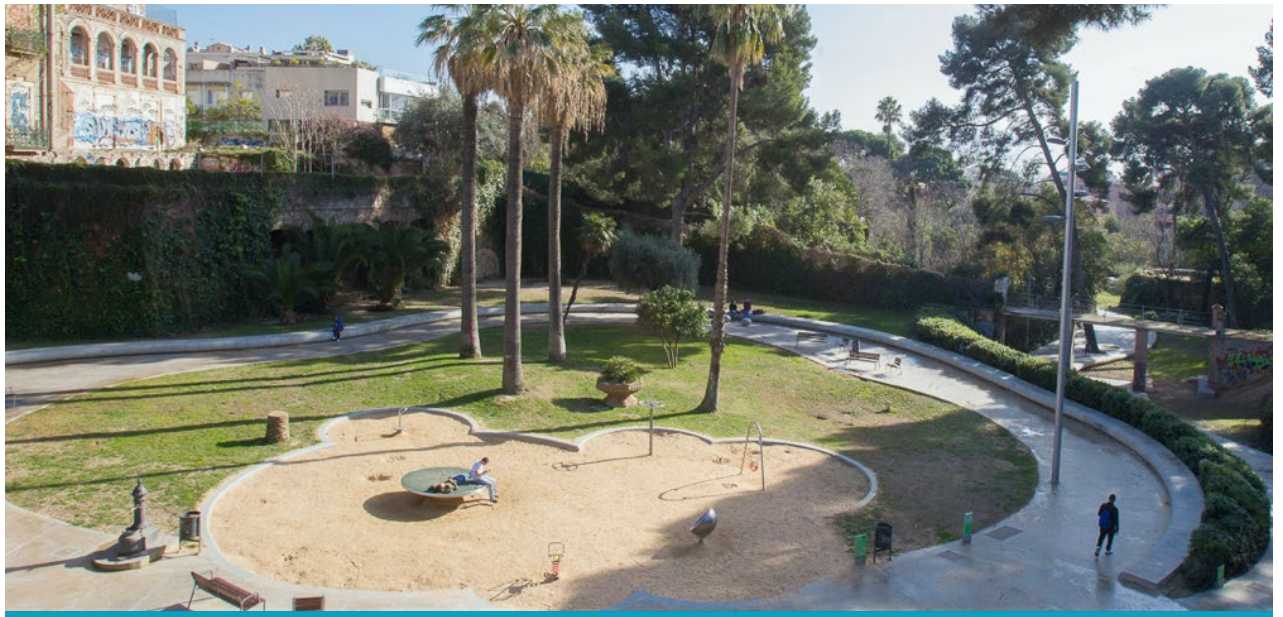
With the dual objective of improving drainage problems associated with the increase in the watertightness of urban spaces and improving the harnessing of rainwater, in recent years, the City Council has promoted the implementation of SUDS in different green spaces across the city.

The SUDS serve a similar function to natural filtering processes, storing and leaching run-off water, acting in a separate and complementary manner to the network of collectors and tanks. They offer a wide range of benefits to the city as they increase the green surface area, capture rainwater from the surrounding areas to help plant life to flourish and leach water into the subsoil to recharge the aquifer. In addition, the water captured by the SUDS does not go into the sewerage system, reducing the volume of discharges from the unitary system into the receiving environment and reducing the peak discharge reaching purifiers during rainfall.

Recently, a study has been carried out which compiles and analyses SUDS experiences in Barcelona, in order to develop criteria and lines of action.

Action plan in the event of inadequate drainage or flooding

Barcelona has a municipal emergency action plan due to the risk of inadequate drainage or flooding, which defines the municipal services coordination and operational model in order to minimise the effects of flooding. The City Council has added an annexe for waves (Protocol for the Plan for risk of inadequate drainage/flooding due to bad sea conditions), as a result of surges that periodically affect the city's coast, which, in addition to leading to the movement of sand, place the safety of people at risk and cause harm to beach fixtures.



Parc de Joan Reventós has a sustainable drainage system that collects rainwater through various kinds of draining surfaces, which filter it while purifying it, before it eventually reaches the subsoil. In the event of a downpour, the water is kept in the retention area or anti-flooding areas created for that purpose.

9.4 Future goals and measures

One of the main challenges is to ensure an efficient and optimised water cycle, both at a city level and also in the metropolitan area. This will become even more significant in the future as, on account of climate change, a reduction in water resources is forecast together with increased demand.

In this context, the challenge is to make guaranteed water supply for human consumption demands compatible with maintaining rivers in a good hydromorphological and ecological state. Achieving this objective requires exhaustive knowledge of the entire water cycle.

9.4.1 Actions to resolve the availability of water resources in the city

Technical Plan for Using Alternative Water Resources (2017-2022)

The new alternative water resource plan sets out the following lines of action to achieve the objectives proposed:

- Improving and expanding the leveraging of groundwater to supply 70% of the total demand of municipal services with this type of water.
- Harnessing regenerated water, in such a way that in residential, commercial and industrial buildings which have access to the general network of regenerated water and do not use other alternative water resources, connection is mandatory.
- Harnessing grey water, on a mandatory basis for new constructions and comprehensive renovations of buildings (>16 households), hotels and sports complexes, to achieve savings of 30% in drinking water consumption.
- Harnessing rainwater from roofs, on a mandatory basis for buildings with non-crossable roofs and without any other way of harnessing alternative water resources.
- Harnessing rainwater upstream, providing for the construction of 10 tanks with a capacity of 60,600 m^3 for municipal uses.
- Treating rainwater in public spaces using SUDS to manage 85% of rainfall episodes.

Taken together, these measures would provide 21 hm^3 per year and, therefore, satisfy expected demand, including the additional 18 hm^3 set out in the 2050 Climate Plan. That aside, it is worth noting that the desalination plant is available as a source of water, although in the context of climate change, where the aim is to increase adaptation and resilience, its use to cover the increase in demand for water has been ruled out, as the infrastructure consumes a large amount of energy and money.

2018-2030 Barcelona Climate Plan

It is also worth noting that one of the strategic objectives set out in the 2030 Climate Plan ⊕ is to reduce water consumption to achieve domestic drinking water consumption of less than 100 litres per inhabitant per day. To achieve that target, the Plan has set out a number of measures:

- **Increase soil permeability by defining a sustainable urban drainage strategy for Barcelona** that offers design recommendations in a manual, maintenance protocols (with professional training to ensure it is done correctly) and sets out recommendations on how to monitor and evaluate its effectiveness using monitors and sensors.

→ Have a **city supply plan** for Barcelona.

→ **Promote the use of grey water** in new housing developments and renovations or for industrial purposes, and study its inclusion in future versions of the Municipal Urban Environment Byelaw.

→ Study the feasibility of **producing regenerated water at the Besòs EDAR to feed the Besòs aquifer**, in order to maintain the river's ecological flows and feed the purification plant.

→ Utilise **regenerated water from the River Llobregat for the industrial uses** of the Zona Franca Consortium and for recharging the aquifer.

Greening municipal activities

Barcelona City Council, an environmental benchmark for the city

Greening municipal activities

Vision of the future

Reduce the negative environmental impact associated with municipal activities and lead the change towards a more sustainable model by example

Current situation

Procurement

100% of electricity procured is green

84% of wood consumed is from sustainable forestry operations

89% of office paper consumed is recycled

<90% of the food served in municipal nursery schools comes from ecological agriculture

56% of the municipal fleet of vehicles is powered by low environmental impact technology

7 municipal buildings are "Bicycle friendly building" certified

62-80% of selective waste collection at municipal buildings compared to 36% elsewhere in Barcelona

9% reduction in tap water consumption by municipal services compared to 2007

Lines of action

Sustainable public procurement
"New mayoral decree"
"Sustainable Public Procurement Plan" "Technical instructions for environmental procurement"

Best sustainability practices in internal operations "Local power generation"
"Prevention of waste and promotion of the circular economy"
"Sustainable mobility"

Networking and exchange of experiences
"JornadA+S"
"Ten recognised best practices"

Sector planning
"Strategic Internal Sustainability Plan for Prevention and Safety Management, Urban Ecology and the Barcelona Institute of Culture"

Greener events
"Reusable cups at community celebrations, BSM installations and sports events"

10.1 Vision, challenges and opportunities

Vision of the future

Barcelona City Council wants to reduce the negative environmental impact associated with its municipal activities and lead the change towards a more sustainable model by example. To achieve this, it is working towards a green and circular economy, promoting equality and transformation towards a fairer society, using its potential as a responsible consumer and being consistent with the message transmitted to residents.

For some time now, the City Council has been staunchly committed to introducing sustainability criteria in its activities and management approach. The main opportunities and challenges to be overcome are as follows:

- **The City Council is moving towards a new organisational culture with more cross-cutting management.** The City Council manages more than 1,000 buildings and employs nearly 12,000 workers, spread across a wide number of departments and divisions, which have decentralised procurement budgets. Coordination, monitoring and expansion of the sustainability strategy throughout the organisation is one of the main challenges of the "More Sustainable City Council" programme.
- **The City Council has a long tradition of internal greening.** In 2001, the government measure on making municipal services greener was approved, giving rise to the "Green Office" programme. Since then, and following the creation of the "More Sustainable City Council" programme in 2006, internal greening and sustainable public procurement have been consolidated.
- **Public procurement is acquiring a strategic role.** At a European level, public procurement is becoming an instrument of political strategy for moving towards a low-carbon, circular economy. In addition, Barcelona City Council is of sufficient size for its actions to have a real impact on environmental improvements in the city, besides setting an example for other sections of the population.
- **The More Sustainable City Council programme forms part of the Citizen Commitment to Sustainability.** After an intense participatory process, Barcelona defined its Agenda 21 in the 2002-2012 Citizen Commitment to Sustainability, subsequently updated to 2012-2022. The City Council, as the first organisation adhering to the Commitment, has reasserted its leadership and role in the More Sustainable City Council programme.
- **The City Council has defined new sustainable public procurement regulations.** Since the first government measure on making municipal services greener, the greening of all municipal procurement has been consolidated with successive government measures, mayoral decrees and other regulations that have reinforced the inclusion of environmental criteria in the procurement of works, products and services. Recently, thirteen sets of instructions have been approved to apply sustainability criteria in the procurement of products and services and the Environmental Public Procurement Guide has also been produced.

10.2 General context and current situation

As part of the transition towards sustainability, Barcelona City Council is primarily responsible for promoting policies and programmes that include environmental and social criteria. This strategy is essential in reducing the negative impact of public activities and promoting a green, circular economy, using the Council's potential as a responsible consumer as well as the example it sets.

The approval of the government measure on making municipal services greener in 2001 gave rise to the creation of the "Green Office" programme. Based on the positive experience of this programme, in 2006 the City Council developed the More Sustainable City Council programme ⊕. Thus, the programme switched from the "Office" to the "City Council", as the work environment includes offices, but also the procurement of works, products and services; and from "green" to "sustainable", as more ethical and social aspects, such as fair trade, are taken into consideration.

This change has been reinforced with the approval of three government measures: one on making municipal contracts greener (2006) to mainstream the inclusion of environmental criteria in procurement and which contains the amendment to standard procurement specifications, and two on responsible procurement (2008 and 2013) to include environmental and social aspects and specify their inclusion in public procurement. The Mayoral Decree for responsible public procurement with social and environmental criteria was also approved in 2013.

A participatory process to promote sustainable public procurement. The More Sustainable City Council programme is led by the Sustainability Strategy and Culture Department at the Urban Ecology Manager's Office and works in collaboration with other areas, districts and municipal institutions to promote environmental improvement initiatives within the municipal organisation. The strategic objectives and lines of action were defined in 2010 at the More Sustainable City Council Convention, an internal participatory process lasting one year that involved more than 300 council workers. Seven years later, in November 2017, JornadA+S was held, to celebrate the success stories of the initiative and set new priority commitments. Greening all municipal procurement is one of the main goals of this programme.

10.2.1 Barcelona City Council, setting the benchmark in sustainable public procurement

Acknowledgements received. The City Council has received a wide range of acknowledgements for its role in this area, notably publication of the municipal nursery schools dining room service ⊕ (2014) and the More Sustainable City Council programme ⊕ (2016) as best practices by the European Commission; selection of green electricity procurement by municipal facilities and the "Bicycle friendly building" certification of municipal buildings as innovative environmental experiences by the Catalan local government Good Practices Bank ⊕; and the 2018 European initiative award ⊕ and the 2018 European initiative award for sustainable procurement for the Procura+ network.

10.2.2 Coordination and networking at different levels

As part of the internal plan, the More Sustainable City Council programme has a range of working groups that meet on a regular basis to address topics such as greening initiatives in general, the sustainable procurement of

wood or vehicles, or buildings. Occasionally, other specific groups are created to address aspects such as making events greener or innovative procurement.

In the external plan, the City Council is a founding member of the Procura+ campaign organised by ICLEI (Local Governments for Sustainability) and actively participates in regional and international projects and networks created to share experiences and best practices and to promote local environmental policies: SMART SPP, Eurocities, Electronics Watch, the Network of Cities and Towns Progressing Towards Sustainability (Barcelona Provincial Council) or the Catalan Network for Ethical Public Procurement, among others. Furthermore, it also collaborates closely with other key actors in the city, such as universities, manufacturers' associations, suppliers, NGOs, and so on.

Collaboration with the main Catalan public authorities. In 2017, a green public procurement working group was set up by the main Catalan authorities, made up of representatives from Barcelona City Council, the Barcelona Metropolitan Area, Barcelona Provincial Council, the Association of Catalan Towns and Cities, the Consortium of Catalan Universities and the Generalitat of Catalonia. The group's aim is to ensure the coordination, exchange and harnessing of resources between Catalan public authorities in the promotion and implementation of green procurement across Catalonia.

10.2.3 Increase in procurement of environmental products and services

Based on the environmental criteria established in the Technical Instructions for the Application of Sustainability Criteria in the procurement of products and services identified as a priority, the main results obtained are as follows:

- **Electricity.** Since 2015, 100% of the electricity contracted by the City Council has been green electricity with a renewable source guarantee or high efficiency cogeneration guarantee.

- **Communication elements.** Over the course of 2017, the Communication Department at the City Council requested the production of 7,800 mono-material polypropylene banners (without PVC) and the string used for the seams was also polypropylene, meaning it can be reused or recycled for banners in the future. In addition, 64% of municipal agencies and districts have used recycled paper to produce communication items, and the Framework Agreement for the Procurement of Graphic Arts Material calls for the use of recycled paper (or non-recycled paper from sustainable forest sources).

- **Computer equipment.** Computer equipment obtained by the Municipal Information Technology Institute meets the criteria for energy saving and efficiency, restricting sound and harmful substance emissions and recycling production material. Prerequisites have also been included to ensure compliance with employment rights in the supply chain of products, after signing up to the international Electronics Watch initiative.

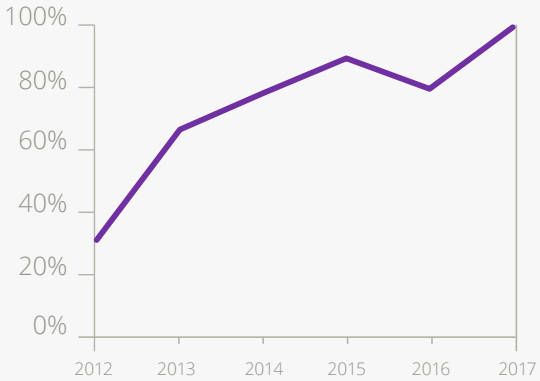
- **Events.** For a number of years now, the districts of Gràcia and Sants-Montjuïc have replaced single-use cups with reusable cups at their annual festivals and, since 2015, BSM has followed this example too at its events and facilities. The Barcelona Sports Institute has also promoted the replacement of plastic bottles with paper cups at certain sports events it organises and has made efforts to make other major events greener.

- **Wood.** Between 2013 and 2017, of the 1,668 m^3 of wood acquired and for which information is available, 84% was sourced from forestry businesses with the sustainable management certificate.

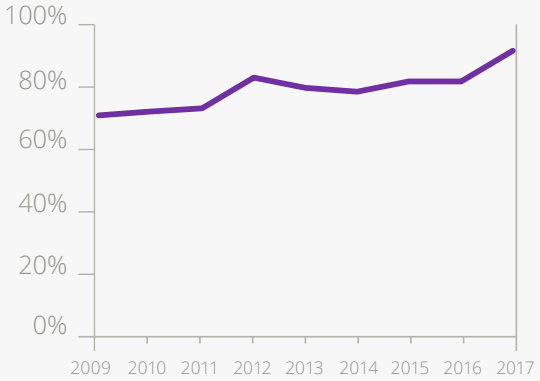
- **Paper.** Eighty-nine per cent of the office paper used at municipal and district offices in 2017 was recycled; and at 16 municipal and district offices, recycled paper accounts for more than 80% of all paper consumed.

- **Textiles.** The inclusion of environmental and social criteria in uniform procurement specifications sets a benchmark. The uniforms worn by BSM, Parks and Gardens, the City Police (GUB) and the Fire Prevention, Extinction and Rescue Service staff include environmental and social criteria, so they comply with

Consumption of wood from sustainable forestry businesses



Consumption of recycled A4 paper



the requirements to limit the presence of chemical substances and respect workers' rights set out in the International Labour Organisation declaration during the production process. In addition, BSM has introduced measures to minimise packaging and to use recycled packaging materials.

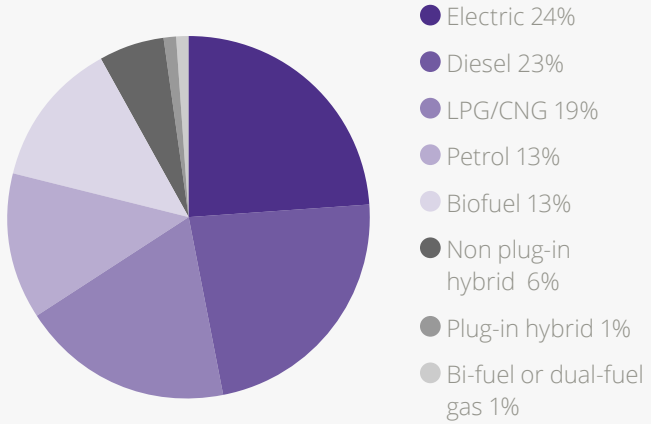
→ **Public works projects.** Most draft construction project, public space and infrastructure contracts involving BIMSA, which accounts for about half of all municipal works, include environmental criteria regarding the source of the wood, energy and water self-sufficiency,increasing greenery and biodiversity, and in favour of the circular economy, amongst others.

→ **Food services.** More than 90% of the food served in municipal nursery schools comes from ecological agriculture In addition, the specifications also include environmental criteria concerning tableware, the cleanliness of facilities and waste management.

→ **Waste collection and cleaning services at municipal buildings.** The contract, in addition to criteria relating to selective waste collection, provides for the use of less toxic products, 100% recycled toilet paper and paper hand towels, and environmental training for staff, among other aspects.

→ **Vehicles.** In 2018, of the 328 vehicles (motorbikes, cars, quadricycles, vans and trucks) incorporated into the municipal fleet, 78% were low-emission and 31% were electric. This process is reflected in the environmental improvement of the fleet: 52% of the light fleet are low emission vehicles (47% with the Zero or Eco label). If we take all vehicles into account, including trucks and other special vehicles, the result is 51%. Worth particular note is the greening of the City Police (GUB) fleet, with 60 electric scooters and 157 hybrid cars; the BCASA fleet, with 128 electric vehicles; the BSM fleet, with 111 vehicles, and the cleaning and waste collection service, with 278 electric vehicles.

Municipal fleet of vehicles



10.2.4 Municipal workers committed to the environment

The application of best environmental practices in internal operations represents a commitment to conserving the environment, while generating energy and financial savings and improving the quality of life in the workplace.

→ **Energy consumption:** in 2018, the city's districts and the City Council managers' offices consumed 55.2 MWh of electricity and 14.7 MWh of natural gas. There are currently 60 municipal buildings and facilities with photovoltaic generation systems and a dozen pergola generators have been installed in city parks and squares. In addition, a further 10 systems are being set up on existing buildings and another 17 have been sent out to tender, such as Cotxeres de Sants and Escola Bosc de Montjuïc.

→ **Water consumption:** in 2018, the city's districts and the municipal managers' offices consumed 488,834 m^3. Consumption by municipal services has decreased from 8,158,331 m^3 in 2001 to 5,605,975 m^3 in 2015, although this has since levelled off (consumption in 2017 was 5,812,870 m^3). This drop can be attributed to management improvements and the gradual increase in the consumption of groundwater: in 1999, 301,730 m^3 was consumed and in 2012, 1,269,752 m^3, levelling off thereafter.

→ **Paper consumption:** each year, a report is drawn up on the consumption of recycled and non-recycled paper. Compared to 2016, in 2017 almost all agencies and directorates reduced paper consumption. Compared to 2013, consumption has fallen by 3.73%, from 50,674 packets to 48,783 in 2017.

→ **Waste generation and selective waste collection:** every four years, an audit is performed on certain municipal buildings to quantify waste generation and selective waste collection. The most recent audit, in 2016, demonstrates an overall reduction in the amount generated, mainly on account of the significant decrease in paper and cardboard, in addition to the strong results in terms of the selective waste collection of these materials. However, there is still significant room for improvement in the selective waste collection of light packaging and organic matter.

→ **Bicycle friendly buildings:** the City Council has seven municipal buildings certified as "Bicycle friendly buildings" and, currently, around 20 more buildings are undergoing audits to obtain this certification. The requirements correspond to bicycle accessibility to the building, indoor and outdoor parking spaces for bicycles, signage concerning access by bicycle, policies to promote bicycles in the workplace and other additional services offered to cyclists.

10.2.5 Growth in sustainability certifications

Implementation of environmental management systems at municipal institutions. Another support tool for internal greening processes and sustainable public procurement are environmental management systems, including EMAS and ISO 14001, in particular to establish environmental improvement initiatives and indicators to monitor the environmental impact of processes and activities performed. Currently, four municipal organisations are ISO 14001 certified. The Urban Ecology Manager's Office, Transports Metropolitans de Barcelona, Clavegueram de Barcelona and Barcelona de Serveis Municipals.

10.3 Measures implemented to make the City Council greener and promote the green and circular economy

10.3.1 Sustainable public procurement for the city's sustainable development

Technical environmental procurement instructions

In 2015, the More Sustainable City Council programme created Technical instructions for the application of sustainability criteria ⊕ to respond to and complement the 2013 government measure on responsible public procurement with social and environmental criteria. The instructions propose specific environmental criteria that must be applied in the acquisition and procurement of product groups and services defined as priorities: electricity, communication elements, computer equipment, events, wood, office equipment, paper, textile products, public works projects, food services, cleaning services and waste collection from buildings, and vehicles.

Making major urban service contracts greener

Major urban service contracts, as may be the case of lighting, sewerage, paving or fountain maintenance services, in addition to others, have systematically been including the priority environmental criteria defined in the technical instructions.

New mayoral decree and Environmental Public Procurement Guide

In 2016, approval was given for the setting up the Public Procurement Committee ⊕ at Barcelona City Council was created as a space for debate and reflection with the city's social, economic and environmental partners. In 2017, the City Council approved the new Mayoral Decree ⊕ on responsible and sustainable public procurement, which contains the technical environmental procurement instructions approved in 2015. Thus, the administrative clauses must include environmental and social criteria and requirements for reducing the importance of the financial bid

To promote the implementation of the instructions and facilitate the introduction of environmental criteria when drawing up the specifications for the acquisition or supply of goods, services and works, the City Council has produced the Environmental Public Procurement Guide (2017) ⊕, with technical instructions and environmental criteria for other procurement outside the scope of application of the instructions.

Creation of the first Sustainable public procurement plan

In compliance with the new Mayoral Decree, the first Sustainable Public Procurement Plan ⊕ has been drawn up with the objectives that the municipal organisation as a whole must achieve in 2018 in this area. Specific targets have been established for each set of technical instructions. For example, more than 90% in the case of recycled paper across the City Council as a whole.

It is planned to continue with the Sustainable Public Procurement Training Plan, thanks to which it has been possible to disseminate the content of the decree and the guides to almost the entire organisation. A computer application is also being rolled out to monitor contracts. Furthermore, a project is being worked on to create a

virtual community in the field of sustainable public procurement to exchange of ideas, proposals and best practices.

New technical instructions on sustainability in exhibitions

Following the production of technical instructions and in response to the 2013 Mayoral Decree on responsible public procurement with social and environmental criteria, the Barcelona Culture Institute (ICUB) opted to improve the quality and efficiency of its facilities and its activities, to decrease its environmental impact on the surrounding area and offer a better work space and experience to both employees and users, through adequate environmental management. As a result of this process, the ICUB produced its Strategic Sustainability Plan ⊕ (2016) and the Technical Instructions for the Application of Sustainability Criteria to exhibitions ⊕ (2017).

Assessment of the impact of public policies relating to the green and circular economy

In collaboration with Estudi Ramon Folch, a study ⊕ has been carried out to evaluate the impact of the City Council's public policies relating to the green and circular economy (GCE) between 2016 and 2019. The results obtained demonstrate that the City Council's investments and spending on GCE accounts for 13% of the average annual budget for the period analysed. The areas with the highest investment are mobility and air quality (64%), the improvement of urban greenery (16%) and waste management (11%). These policies have created an annual average of over 5,200 direct temporary jobs, and at least 1,380 permanent jobs.

The study also proposes future initiatives that would further boost economic development, job creation and the environmental benefits of the 12 areas analysed.

10.3.2 Best environmental practices in internal operations

Energy saving and local energy generation measures

In line with the Energy Saving and Improvement Plan for Municipal Buildings (PEMEEM), work is ongoing to encourage energy savings and improve energy efficiency, as well as increase the generation of green, local energy at municipal buildings and facilities. Some of the measures adopted include the implementation of energy saving and efficiency systems in thermal and lighting facilities; improvements to thermal enclosures; the installation of photovoltaic generation systems, hot/cold distribution networks and autonomous and self-sufficient lighting; compensation of emissions generated by municipal publications of events and the promotion of the energy culture through awareness raising campaigns *(see Chapter 1, "Energy and climate change mitigation")*.

Measures for saving water and responsible use

To reduce water consumption at municipal buildings, inefficient systems have been replaced with water saving mechanisms (Presto system for taps and double discharge systems in cisterns), waterless urinals have been installed and mechanical cleaning is now employed at markets.

City-wide, measures have been implemented to increase the leveraging of groundwater used to clean the streets and sewerage system, and to irrigate parks and gardens, while flow-regulating devices and purifying systems have been installed at ornamental and drinking fountains. Automated irrigation and drip systems have been installed in parks and gardens that are equipped with rain meters and humidity sensors that make it possible to optimise water consumption and avoid watering when the soil is moist enough *(see Chapter 9 "Water cycle")*.

Paper saving measures

To reduce the consumption of paper at municipal offices, an online processing system has been implemented for council procedures and electronic permits, while the More Sustainable City Council programme provides trays to reuse paper only used on one side and promote the use of double-sided printing by default for all computer equipment at the City Council.

Waste prevention and promotion of the circular economy

With a view to preventing waste generation, achieving internal selective waste collection of 75% and contributing to the exemplary status of the City Council, selective waste collection containers have been installed in shared spaces and specific containers for hazardous waste. Cups, glasses and eco-bins have also been distributed to replace generic desk waste-paper baskets and internal communication campaigns held to promote the circular economy and extend the life of office material. Along the same lines a commitment has been made to make the city's main events and festivities greener by standardising the use of reusable cups and withdrawing single-use glasses, tableware and plastic packaging at fountains, vending machines and outsourced food services.

In terms of promoting the circular economy, the City Council and the Pangea Association signed an agreement in 2018 to hand over tech devices no longer in use, restore them and forward them to social entities *(see Chapter 8, "Waste prevention and management")*.

Measures to make generated mobility greener

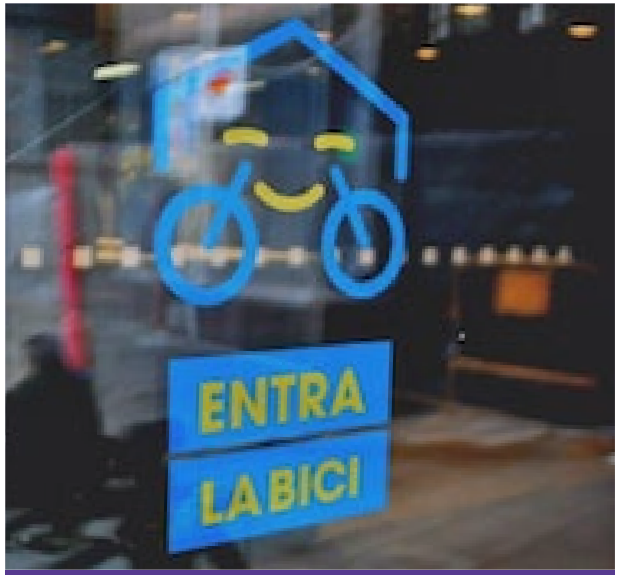
In accordance with the 2013-2018 Urban Mobility Plan ⊕, environmental improvements in municipal-generated mobility are being achieve through two lines of action:

→ Making the municipal vehicle fleet and service contracts greener *(see section 10.2.3, "Increase in procurement of environmental products and services")*.

→ Fostering sustainable internal mobility through the following measures:

- Promoting sustainable and healthy mobility habits in the workplace among municipal employees with "A la feina, Bicia't" (Cycle to work): free bike-lending service, riding in traffic and mechanical training, organisation of excursions, etc. As part of this project, the internal certification "Bike-friendly building" ⊕ was created in 2016. Its requirements refer to bicycle accessibility to the building, indoor and outdoor parking spaces, bicycle access signs, policies to promote cycling to work and other supplementary services offered to cyclists.

- Encouraging the use of electric vehicles by City Council employees.



To date, 7 municipal buildings have been certified and 20 are undergoing the certification process.

10.3.3 Meeting of municipal workers committed to the environmentt

JornadA+S

Seven years after the first More Sustainable City Council Convention, in November 2017 an event ⊕ was held to celebrate the successes achieved and define new priority commitments for reducing the environmental impact

of municipal activities and leading the change by example, including achieving internal selective waste collection of 75% or eliminating single-use cups, glasses and plastic packaging.

At the event, the More Sustainable City Council awards were also presented to ten initiatives for their valuable incorporation of sustainability in different areas of municipal administration, such as greening lunchtime services in municipal public nursery schools or applying energy efficiency measures in the municipal library network.

10.3.4 Municipal bodies and offices with strategic internal sustainability plans (PESI)

Security and Prevention Manager's Office PESI 2015 -2022

In 2015, the Security and Prevention Manager's Office adapted and updated its 2013-2022 Strategic Internal Sustainability Plan (PESI) in order to achieve sustainable development in the areas of its activities in a gradual, cross-cutting and participatory manner.

The content of the Plan is divided into more than a hundred different actions split into six strategic pillars: infrastructures, logistics, telecommunications, mobility, communication and training. Some of the objectives achieved over the past five years under the Plan are as follows:

- Gradual greening the vehicle fleet: the City Police (GUB) fleet has 59 electric scooters and 2 electric vans. plus 154 hybrid cars.
- Rationalisation and efficient use of resources: energy and water consumption in 2017 was down on 2016 by 22% and 19%, respectively.
- Greening contracts: 87% of procurement specifications in 2018 include environmental criteria.
- Setting up the post of sustainability supervisor and the Plan Monitoring Committee.

Urban Ecology Manager's Office PESI 2015 -2022

This strategic instrument defines the internal actions to be promoted by the Office in order to incorporate sustainability into the operations of areas for which it is responsible. Based on the identification of existing best practices and the main challenges for the future, 50 strategic actions were defined to achieve the Plan's objectives, relating to procurement, training, projects, networking, procedures and internal processes.

In April 2018, the first Plan monitoring report, was issued, with internal greenery indicators, a diagnosis of how green contracts are, and a description of the 23 strategic projects developed during 2016 and 2017. Based on this analysis of the Plan's progress, actions to be carried out in 2018 and 2019 have now been prioritised.

ICUB sustainability plan and facility environmental quality guarantee

The Sustainability Plan, drawn up in 2016, is an ongoing, cross-cutting tool to extend sustainability to all ICUB areas and workspaces and to include environmental criteria in the planning, execution and monitoring of activities it carries out. The strategic objectives correspond to four areas of work on sustainability:

- Efficiency and savings in supplies, installations and consumables.
- Consolidation of a proper approach to waste management.
- Promotion of environmental awareness raising and communication.
- Compliance with and improvement of environmental legislation.

The ICUB has also worked to attain the environmental quality guarantee label for the cultural facilities and libraries it manages. Fifteen of its buildings are currently certified.

10.3.5 Making city events greener

Festivals that generate less waste

As part of events instructions, the "Zero Waste" strategy and the new European directive on single-use plastics, various City Council events and functions now use reusable cups to prevent or minimise the generation of plastic waste.

During the 2017 Mercè, Gràcia and Sants-Montjuïc annual festivals, 156,270 reusable cups were used and instead of 210,346 single-use cups, equivalent to 210 kg of waste packaging. BSM has also introduce the use of reusable cups at its own facilities, with 601,669 being used in 2017.

Inclusion of sustainability at sports events

The Barcelona Sports Institute (IBE) has also promoted the replacement of plastic bottles that it distributes to participants and opted for paper cups at some races, such as Cursa de Bombers, Cursa dels Nassos and Cursa de Sant Antoni. Work is continuing to implement this initiative in other races.

Other major events have also been made greener as part of the greening plan. For example, at the 2018 European Water Polo Championships in Barcelona, water fountains were installed rather than distributing bottled water, the maximum possible number of hybrid or electric vehicles were hired and the the reuse of banners and the use of recycled materials in medals and trophies was established. Furthermore, the plan to make Barcelona Marathon and Half Marathon greener includes a sustainable mobility plan and emission offsetting; a waste minimisation, selective collection and correct management plan; an environmental training plan for staff; the progressive rollout of other measures, such as the procurement of textiles with a significant percentage of recycled material from ecological agriculture or fair trade; and the communication of actions to make events greener.

10.4 Future goals and measures

To make progress on greening the City Council and sustainable procurement, in the coming years work will continue in various areas of activity.

10.4.1 New actions and objectives to continue advancing towards a greener City Council

New environmental procurement instructions and updating existing instructions

→ **Amendment to the vehicle technical instructions.** In response to the objectives of the 2018 Sustainable Public Procurement Plan, the Climate Plan and the 2018-2024 Electric Mobility Strategy, these instructions are being adapted and updated to exclude the acquisition of diesel cars and reduce the acquisition other diesel vehicles, as well as prioritise the acquisition of electric vehicles in order to make further progress on sustainable mobility and the electrification of the municipal fleet.

→ **Amendment to public works projects technical instructions.** The public works projects technical instructions are due to be amended to include measures resulting from the government measure "Transition towards Energy Sovereignty" and the Climate Plan, with the installation of renewable energy capturing elements on terraces and roofs of municipal buildings and facilities and in public spaces that have the right conditions.

The aim is also to include criteria relating to bicycle access to municipal buildings, indoor and outdoor bicycle parking, signs and additional services for cyclists, which will enable them to obtain "Bicycle friendly building" certification.

→ **Amendment to food services technical instructions.** In response to the Climate Plan and the 2016-2019 Strategy to Promote Food Policy, it is expected that these technical instructions will be amended to include new aspects, such as the acquisition of local, ecological produce or the promotion of vegetarian menu options.

→ **Drafting the mayoral instructions on single-use plastics and bottled water.** Based on the technical specifications for the procurement of food and events services, and the new European directive on single-use plastic, the City Council is in the process of drawing up instructions to prevent the use of single-use cups, tableware, bottles and other plastic items at municipal offices and services, in addition to the distribution of bottled water.

→ **Drafting the facilities management technical instructions.** New technical instructions are due to be drawn up to facilitate the application of sustainability criteria in facilities management contracts. These cross-cutting instructions will include priority environmental criteria set out in other instructions (cleaning and waste collection, food services, communication elements, exhibitions, etc.).

Monitoring sustainable public procurement

The Procurement Coordination Directorate is working on implementing a computer programme to monitor sustainable public procurement indicators: the SAI application. All procurement units will be required to fill in the information that the SAI requests for each contract that includes social, environmental and innovation measures but the intention is that the contractor should provide most of the information needed to calculate the indicators defined for each measure, also though the SAI application.

Along the same lines, the Climate Plan provides for studying the feasibility of having a green accounting system at City Hall for classifying green-economy actions in the municipal budgets, as well as creating an additional environmental classification.

Extending the application of procurement instructions to all municipal bodies

Although to date, priority has been given to joint work with the municipal areas and bodies that are most representative of each sector, once the introduction of the environmental criteria established in the technical procurement instructions is consolidated, their application must be extended to the other areas and bodies.

For example, BIMSA contracts account for almost 50% of municipal expenditure on works and, therefore, efforts are still required to ensure compliance with the instructions at the bodies responsible for other works. As regards the instructions for food services, collaboration has mainly been with the Barcelona Municipal Institute for Education (IMEB) to green the dining room services at municipal nursery schools and work is now due to start with the Health Consortium, the Education Consortium and other relevant bodies in this area.

To extend the application of the instructions, identifying the contracting bodies of each sector poses a considerable challenge as procurement is decentralised.

Drawing up a green and circular economy strategy

Barcelona is looking to become a city that effectively uses its own resources and substantially reduces its impact on other areas. To achieve this, progress is needed in defining the criteria and mechanisms that enable new environmental objectives to be integrated into procurement: low carbon public procurement, circular procurement, eco-innovative procurement, etc.

In that sense, the plan is to encourage low-carbon public procurement by means of new instructions, changing the existing ones, and actions to promote the circular economy.

Internal greening

In addition to the commitments assumed at the JornadA+S, work is expected in the following two areas:

- **Plans to green municipal bodies.** The More Sustainable City Council programme is pushing for greening plans for each municipal body, that include the following key aspects: consumption of resources, waste prevention, purchasing and procurement with sustainable criteria, internal mobility and a culture of sustainability, among others.
- **Sustainable internal mobility.** An internal mobility plan is due to be drawn up for Barcelona City Council in order to continue making progress towards sustainable internal mobility.

Greening major contracts

Work continues on inserting sustainability criteria in the city's new cleaning and waste collection contract. Notable environmental aspects include the minimum requirements for suing light electric vehicles and the excluding diesel trucks, assessing the reduction of municipal fleet emissions, including noise, and incorporating new technological and data analysis features.

Co-responsibility

In Barcelona, everybody is responsible for sustainability

Co-responsibility

Vision of the future

Becoming a more sustainable city by means of a project shared with organisations and residents

Current situation

Reference framework

2012-2022 Citizen Commitment to Sustainability

1,135 organisations in the More Sustainable Barcelona network

BARCELONA+SOSTENIBLE

Stakeholders

City Council
13 **procurement instructions** for the application of sustainability criteria

Entities and enterprises
641 **entities and enterprises** sharing sustainability experiences and projects

Shops
132 **entities and** **4,700** **shops** adhered to the "More Sustainable Commerce" programme

Schools
352 **schools** in the "More Sustainable Schools" programme

Residents
services and resources from **15** **environmental facilities**

Tools

More Sustainable Barcelona map collaborative tool that reflects the socio-environmental initiatives across the city

Sustainability indicators in the city updated indicators in line with the objectives and lines of action under the Commitment

Lines of action

Expansion of the network "More Sustainable Commerce" "More Sustainable Neighbourhoods"

Shared initiatives and networking "Three new working groups" "Co-creation of the Climate Plan" "Citizen climate projects" "Fem Xarxing"

Monitoring and assessment "New sustainability indicators for the city" "2018 More Sustainable Barcelona convention"

Education and citizen action "La Fàbrica del Sol" "Sustainability Week"

11.1 Vision, challenges and opportunities

Vision of the future

Barcelona wants to become a more sustainable city as part of a project shared with organisations (entities, enterprises, schools and institutions) and residents.

The 2012-2022 Citizen Commitment to Sustainability is a document with strategic value that aims to inspire and serve as a framework for all the organisations and people that want to contribute to improving Barcelona's sustainability.

The schools, entities, enterprises and shops that form part of the More Sustainable Barcelona network assume joint responsibility for building a more sustainable city and are committed to making a contribution, each in their own sphere and collectively. The main opportunities and challenges are as follows:

- **More Sustainable Barcelona is a more mature, committed and diverse network.** Following the growth of the More Sustainable Barcelona network, which now encompasses more than 1,100 organisations, its diversity and intersectoral activities have increased. The experience of networking accumulated over these years has made it possible to work in a more effective collaborative and coordinated way, with a core group of members involved in organisation.
- **The Commitment reaches new sectors, such as trade and tourism.** Since February 2017, 132 shops and associations from the commercial sector have joined the More Sustainable Barcelona network and are promoting sustainability measures as part of their organisation or business. However, more work is required to consolidate the "More Sustainable Commerce" programme. In the case of tourism, progress has been made in defining the Commitment for Sustainable Tourism, in cooperation with Turisme de Barcelona.
- **New challenges for the next five years of the Commitment.** Having reached the halfway point of the Commitment, the More Sustainable Barcelona Convention was held in 2018 to address the milestones in the Commitment's next five years and six future challenges were identified. An action plan to address these is currently being drawn up.
- **A network involved in the city's participatory processes.** Members of the network have contributed to the development of new plans and strategies such as the "Zero Waste" strategy, the Climate Plan, the Coastal Plan and the Urban Mobility Plan, amongst others. This network also generates and develops shared projects, the citizen climate projects, for example.
- **Barcelona City Council is just another member of the network,** although it also acts as a facilitator, by means of a technical secretary who drives the activities of programmes and the network as a whole, provides help, information, training and advice, and coordinates exchange and participatory activities.
- **The challenges are to promote and raise awareness of the Commitment beyond the network of organisations,** to reach all parties, in the case of major organisations, as well as performing useful and rewarding activities for the range of organisations and people involved, with different organisational cultures and degrees of expertise and involvement.

11.2 General context and current situation

Barcelona has a community strategy for sustainable development, promoted by the City Council, which has shared responsibility as one of its main values. The reference framework for this strategy is the 2012-2022 Citizen Commitment to Sustainability ⊕, the result of a broad process that sets out ten objectives, each with ten lines of action. Its aim is to educate and inspire all those organisations and people who wish to contribute towards improving the city's sustainability.

The underlying idea is to build a sustainable city with the contribution of the entire community. Thus, the organisations that participated in defining the Commitment and those that have joined them since have established a local alliance for sustainability initiative known as the More Sustainable Barcelona ⊕ network.

The Citizen Commitment to Sustainability grew out of the local Agenda 21 for Barcelona, following the guidelines set out at the United Nations Conference on Environment and Development in Rio de Janeiro (1992). From the outset of local Agenda 21, the emphasis in Barcelona was on participation to define objectives and citizen involvement in achieving them. In 2002, an initial Citizen Commitment to Sustainability was approved for 2002-2012 and various organisations began to endorse it. A new Commitment was then defined in 2012 and the endorsements were renewed and continued.

The Commitment's ten objectives are cross-cutting and cover most of the contents of the United Nations' Sustainable Development Goals (SDGs) ⊕. These areas are biodiversity, public space and mobility, environmental quality and health, efficient cities, responsible consumption, good governance, people's well-being, the sustainable economy, education and civic action, and global resilience and responsibility.

Organisations that have endorsed the Commitment are committed to drawing up voluntary action plans to contribute to the shared objectives. Currently, there are different types of contribution:

- **Individual action plans and best practices:** each organisation decides the content and scope of its plan.
- **Double-scale action plans:** guilds, traders' associations and professional organisations develop scalable action plans for their bodies or members, who can choose to adhere to the actions proposed.
- **Action networks or "micro networks":** groups of organisations that perform similar actions or share methodologies and results.
- **Collaborative projects:** members of the different organisations joint forces to decide on and carry out an initiative.

Monitoring the Commitment at a city level is done through a system of sustainability indicators ⊕.

11.2.1 More Sustainable Barcelona, a consolidated network

Currently, 1,135 organisations are members of the More Sustainable Barcelona network, including associations, enterprises, schools, universities, professional associations, trade unions, cultural facilities and services, public institutions and Barcelona City Council.

Monitoring of the citizen network in terms of its sustainability actions is divided into sectors:

Percentage of schools participating in the "More Sustainable Schools" programme of all schools across the city, by level of education (2018-2019 academic year)

	public schools	state schools
Nursery schools	30%	7%
Infant and primary education	71%	41%
Secondary education	62%	11%
Infant, primary and secondary education	67%	59%
Adult education	12%	9%
Special education	88%	92%
Total	55%	30%

→ **"More Sustainable Schools"** ⊕: this programme, which seeks to contribute to sustainability from education and recognises schools as agents of change in the city, was created in 2001 as part of the Citizen Commitment to Sustainability. At present, 352 schools play an active part, although, in its 18 years of existence, a total of 461 schools have taken part.

Over the course of these years, the mission of the "More Sustainable Schools" programme has been to support schools in the process of incorporating sustainability criteria into all areas of their educational work. Each school develops its own project and actions to improve the sustainability of the school and the surrounding area, with the direct participation of students. Each school year there is a new call for schools that would like to continue and develop their project, as well as others that want to start one and sign up to this engaging collective project. Furthermore, seven micro networks have been set up over the years, to develop projects focusing on the same theme: Waste prevention plan, "More Sustainable Wrappers", "Ens ho mengem tot", Sssplau, "Tinguem cura del planeta", "Compostem i aprenem" and "Fem campanya per una mobilitat sostenible i segura".

→ **"More Sustainable Entities and Enterprises"** ⊕: programme aimed at entities, enterprises and other organisations who have assumed joint responsibility for building a More Sustainable Barcelona and committed to making a contribution in their corresponding field. In all, 641 entities and enterprises are taking part.

→ **"More Sustainable Commerce"** ⊕: programme commerce and shops which, having joined the More Sustainable Barcelona network, are committed to contributing to the city's sustainability through their activities. This programme encompasses 132 entities from the commercial sector (shops, trade unions and trade associations).

→ **"More Sustainable City Council"** ⊕: programme to green municipal activities *(see Chapter 10, "Making municipal activities greener")*.

→ **"More Sustainable Citizenry"** ⊕: services, activities and resources for spreading the sustainability culture to all citizens. Supported by a team of municipal experts who are the reference persons in each district and a network of facilities that is being consolidated throughout the city.

The "More Sustainable Neighbourhoods" programme places an emphasis on extending the sustainability culture to all neighbourhoods and ensuring residents are informed, aware and capable of acting individually and collectively in transforming their neighbourhoods to obtain a healthier and more sustainable Barcelona.

The Citizen Sustainability Committee ⊕, a participatory body whose members are elected democratically from and by organisations in the network, is responsible for leading the More Sustainable Barcelona network. With help from the Committee, working groups and conventions open to the entire network are organised to define its priorities and influence public policies.

11.2.2 Environmental facilities for expanding the culture of sustainability in the city

La Fàbrica del Sol ⊕: a benchmark facility for environmental and sustainability education. In addition to serving as the headquarters for More Sustainable Barcelona network, it offers an information and advice service on topics such as the urban economy and sustainability, an activity programme for adults and families, the "How does Barcelona work?" programme and a material lending service. As a demo building, it is open to the public to raise awareness of the environmental solutions it incorporates and discover the strategies that can be adopted to live as sustainably as possible.

This facility also house one of the city's fab labs ⊕ which are spaces for creation and training linked to new technologies, especially 3D digital fabrication, applying sustainability criteria; and the Environmental Education Document Service ⊕, which keeps environmental education information and resources, with a particular emphasis on urban issues. In addition, the More Sustainable Barcelona Secretary's Office is based there.

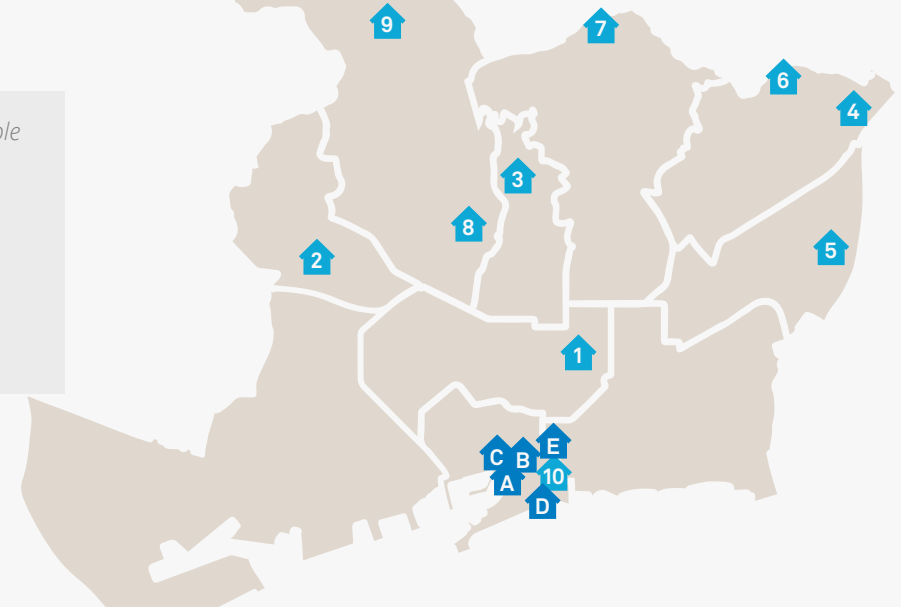
The Beach Centre ⊕: an information and environmental education centre on Barcelona's coast. Since 2017 it has included the Beach Laboratory, a travelling module that tours the beaches with educational activities to raise awareness of the marine and coastal ecosystem. In

City facilities:

- **A LA FÀBRICA DEL SOL**
  Passeig de Salvat Papasseit, 1
- **B SERVEI DE DOCUMENTACIÓ D'EDUCACIÓ AMBIENTAL**
  Passeig de Salvat Papasseit, 1
- **C ATENEU DE FABRICACIÓ**
  Passeig de Salvat Papasseit, 1
- **D EL CENTRE DE LA PLATJA**
  Pg. Marítim Barceloneta, 25-29
- **E ESPAI LÚDIC AMBIENTAL PER A FAMÍLIES DEL PARC DE LA CIUTADELLA**
  Pas de l'Institut Escola, 1

District facilities:

- **1 Aula ambiental de la Sagrada Família**
  Carrer Lepant, 281-283
- **2 Aula ambiental de Les corts-Can Déu**
  Pl. Concòrdia, 13
- **3 Aula ambiental del Bosc Turull**
  Passeig Turull, 2
- **4 Casa de l'Aigua**
  Carrer Garbí, 2
- **5 Aula ambiental de Sant Andreu**
  Carrer de la Foradada, 36
- **6 Castell de Torre Baró**
  Ctra. Alta de les Roquetes, 309-311
- **7 Centre de natura de Can Soler**
  Carretera de sant Cugat, 114/132
- **8 Centre cívic Vil·la Urània**
  Carrer Saragossa, 29
- **9 Centre cívic Vallvidrera**
  Carrer dels Reis Catòlics, 16
- **10 Aula Ambiental de Ciutat Vella La Fàbrica del Sol**
  Passeig de Salvat Papasseit, 1



In 2016, 4,000 people participated in the activities organised there and almost 3,000 have visited exhibitions at La Fàbrica del Sol.

2018, 2,380 people participated in the range of activities offered.

In addition, the city has environmental classrooms in each district that work together with the environmental facilities in the city and the districts (cultural facilities, organisations, events) with shared objectives and a joint working programme. Currently, there are ten environmental classrooms in eight districts:

Gràcia: Bosc Turull Environmental Classroom ⊕: municipal environmental education facility focussing on improving biodiversity, knowledge and protection of woodland, in addition to extending the sustainability culture throughout Gràcia.

Eixample: Sagrada Família Environmental Classroom ⊕: located at the neighbourhood's green point and, in addition to offering a quarterly programme of activities, it is an information point for waste management as well as providing a community compositing space for families in the Sagrada Família neighbourhood.

Les Corts: Les Corts Environmental Classroom ⊕: located in the Can Deu Civic Centre, it educates local residents on the resources and tools available to make everyday life more sustainable and environmentally friendly

Nou Barris: La Casa de l'Aigua ⊕ and Castell de Torre Baró ⊕: environmental classrooms located in Nou Barris that promote environmental education in the district with a particular focus on the city's link with the Serra de Collserola and the environmental values of the Besòs river and Rec Comtal.

Sant Andreu: Sant Andreu Environmental Classroom ⊕: provisionally located at Espai Via Barcino in Trinitat Vella, it educates locals on the resources and tools available to make everyday life more sustainable and environmentally friendly.

Sarrià: Vil·la Urània Civic Centre ⊕ and Vallvidrera Cívic Centre ⊕: respectively focus on the connection between science and the environment and knowledge of Parc de Collserola.

Horta-Guinardó: Can Soler Nature Centre ⊕: a new space at Can Soler dedicated to nature and sustainability and promoting the natural and cultural heritage of the surrounding area.

Ciutat Vella: Ciutat Vella Environmental Classroom ⊕: located in La Fàbrica del Sol, its specific objective is to spread the sustainability culture in Ciutat Vella.

In addition, Parc de la Ciutadella is home to LaLudo ⊕, a facility specially designed for families with children aged between 0 and 5 where they can enjoy a recreational environmental space that promotes free play and active participation in the conservation of nature and which seeks to spread the sustainability culture.

11.3 Measures implemented to spread the sustainability culture

11.3.1 The More Sustainable Barcelona network expands

"More Sustainable Commerce" ⊕, new programme in the More Sustainable Barcelona programme

After a number of years working with the various programmes embraced by the More Sustainable Barcelona programme, the need to create a specific programme for shops was identified. So, in February 2017, retailers associations and shops signed the Commitment and became part of the More Sustainable Barcelona network.

Retail associations must draw up a sustainability action plan each year, including actions that encourage their members to improve the sustainability of their business. Each association establishment can sign up to the actions proposed in its association's action plan and propose its own actions. There are various spheres of action: saving energy and water, waste prevention and management, sustainable mobility, (goods, workers and customers), responsible consumption (products sold and own consumption), responsible procurement, and so on.

Over the past two years, 128 action plans have been drawn up and signed by 4,758 establishments.

11.3.2 More information on the city's sustainability

More Sustainable Barcelona map

The More Sustainable Barcelona map ⊕ is a collaborative tool that shows the main socio-environmental initiatives in the city: environmental facilities and installations, flora and fauna refuges or trails, shops, accommodation, infrastructures and, in general, all initiatives that promote the green economy and contribute to improving the urban environment, the building of a more equal and inclusive social structure and enriching the community and neighbourhood fabric. In addition, it is an interactive virtual map that allows people to add information about each point, such as reports, photos and activities.

Currently, 1,493 points of interest have been registered on the More Sustainable Barcelona map. Most are shops and services (90.4%; 1,350 points) and, of these, most are shops where products can be obtained in bulk (392).

City sustainability indicators

Since 2002, the City Council has had a number of indicators ⊕ to measure progress from the perspective of sustainable development, as they have made it possible to synthetically and globally gather information on areas of activity and analyse performance.

Following the creation of the new, 2012-2022 Citizen Commitment to Sustainability, clearly showed the need to update the series of indicators in line with new objectives and lines of action. These indicators deal with the

social, environmental and economic aspects of the More Sustainable Barcelona programme in a comprehensive manner and are intended to work with quality data, be easy to communicate and last.

11.3.3 Schools that transform the city

The mission of the "More Sustainable Schools" programme is to help school teams promote the sustainability culture and incorporate sustainability criteria in all aspects of educational tasks: the physical environment, school management, the syllabus, daily life and the community.

The More Sustainable Schools team assists teachers in taking action, so they can reflect on what does not work and take steps to improve it ,and put real transformation projects into practice that will become a learning and training process, a good experience that empowers students.

The schools that form part of the "More Sustainable Schools" programme must develop a project each school year, an action plan to improve education in terms of the sustainability of schools and the surrounding areas, with support from a specialist team. The most experienced schools have the option of presenting a project every three years. That way, students and teachers can analyse the conflicts in their immediate surroundings, consider perspectives and alternatives, contribute to the solution of the problems identified and transform this analysis and action process into an educational resource.

The "More Sustainable Schools" programme secretary's office offers technical and educational training and advice, support materials, dissemination tools and financial support. Each school year, teacher training sessions are organised which around 800 teachers take part in.

"More Sustainable Schools" micro networks

Micro networks are school networks that develop projects focused on the same theme at the same time. The secretary of the programme oversees and monitors progress and, in some cases, offers specialist resources and techniques. This enables experiences to be exchanged and shared and data compared. Over the years, seven micro networks have been set up:

Sssplau: students take measures to combat noise in different areas of their schools to create a noise map and perform actions to improve acoustic quality.

"Tinguem cura del planeta": project that invites young people from around the world to reflect and take action to improve the planet. Nine Barcelona schools took part in the 6th Catalan "Tinguem Cura del Planeta" Conference.

Waste prevention plan: the objective of this initiative is to offer advice to schools interested in implementing a waste prevention plan and offer individual monitoring. Ten schools participated in the 2017-2018 school year.

Seventeen schools participated in the 2017-2018 school year, and nine created a noise map.

"Ens ho mengem tot": educational initiative to work on food waste with students and dining-room staff. Twenty-six schools took part in it.

"More Sustainable Wrappers": the objective of this initiative is to reduce the packaging used for packed lunches

based on a wrapper prevention plan. Fifty-six schools took part in it.

"Compostem i aprenem": in order to introduce composting into the daily routine of schools and families, the former are provided with a range of materials and services for composting. In all, 21 schools took part and 10 compost bins and 5 vermicomposters were distributed.

"Fem campanya per una mobilitat sostenible i segura": this new micro network offers the possibility of learning how to design a communication campaign, with the aim of raising awareness about the importance of safe mobility in the areas surrounding schools. Nine centres participated in the first edition of this initiative.

Programme resources

A series of resources ⊕ are offered to schools belonging to the network, for example, the option of acquiring plants, compost and guard bed materials to complement actions in school allotments and gardens; the Punt Verd Mòbil Escolar, a truck that visits schools to selectively collect valuable and special waste; the "How does Barcelona work?" programme, with more than fifty activities to learn about infrastructures, facilities, actions and services and raise awareness about the challenges facing the city's functioning, and the "Apropa't als parcs" programme, that proposes re-conceiving parks as an educational space, structured around making responsible use of the space, understanding it, viewing it, enjoying it and, if possible, taking actions to improve it.

Each year, around 196 schools and 11,000 students participate in 500 activities as part of the "How does Barcelona work?" programme.

11.3.4 Efforts to bring sustainability closer to Barcelona's residents

Environmental education programmes

The City Council promotes a series of environmental measures and educational activities to develop the sustainability culture and help Barcelona's citizens acquire new values, attitudes and change their behaviour.

→ "How does Barcelona work?" ⊕: educational programme that offers more than 50 activities, including visits, tours and workshops so that, by getting to know the city's environmental management facilities, habits and values are generated that will enable us to progress towards a more sustainable Barcelona.

→ "Sembra natura" ⊕: La Fàbrica del Sol organises sustainable gardening and horticulture workshops for the general public to give them knowledge and methods so they can enjoy gardening and horticulture at home, and to contribute to creating a greener, more inhabitable and healthy city.

→ "Carrega't d'energia" ⊕: workshops that seek to provide people with information and train them so we can move towards a new energy model: to understand, control and reduce electricity consumption, improve efficiency in the home and the commercial sector and to promote the installation of power generating appliances.

→ Cicle Claqueta i Acció ⊕: films and documentaries are screened at the International Environmental Film Festival (FICMA) in civic centres and cultural centres, with a lively debate following each one.

"More Sustainable Neighbourhoods"

The "More Sustainable Neighbourhoods" project has been launched, with a local sustainability culture programme for neighbourhood cultural centres and events. The objective is to ensure residents are informed, aware and capable of acting individually and together in transforming their neighbourhoods for a healthier and more sustainable Barcelona. "More Sustainable Neighbourhoods" has a network of sustainability reference persons in the districts and a network of city and district environmental facilities.

Renovation of La Fàbrica del Sol

After a year of renovation work, on 28 January 2018, La Fàbrica del Sol reopened with an open day of workshops, dramatised visits and environmental activities to inaugurate a refurbished environmental facility that has become a benchmark demonstration building in the city.

Its refurbishment involved integrating environmental measures and solutions, such as harnessing rainwater, a vertical indoor garden, a geothermal heat pump, a pergola and a dividing wall with photovoltaic panels, as well as natural ventilation. The work has also served to reorganise the layout and install a permanent exhibition that explains how the building works in energy terms.

Thanks to these changes, it now has an "A" energy rating and the "Bicycle friendly building" label. Among other recognitions, it has also received the five leaves of the "Segell Verd", a sustainable building certificate.

Sustainability Week

World Environment Day, held on 5 June, is a United Nations event for raising awareness and calling on world action to protect the environment. All over Europe, the week prior to that is European Sustainable Development Week.

Barcelona joined in these two initiatives with Sustainability Week, from 30 May to 5 June 2018. For that, the City Council and the More Sustainable Barcelona Network organised a full week of workshops, visits, routes and activities that offered first-hand knowledge of how Barcelona is being transformed to become healthier and more responsible city. Worth particular mention are the urban biodiversity workshops, a popular landscaped area on Carrer de Girona, dramatised visits to La Fàbrica del Sol or the 12 walks to discover different aspects of the city linked to sustainability, such as the seafront or the sewerage system, and from different perspectives, including gender and responsible consumption.

The week came to an end with an event to celebrate World Environment Day, organised by the More Sustainable Barcelona network, as part of which the environmental state of the city was analysed and the ten best

practices developed by members of the network in 2017 were acknowledged.

Citizen Science Office

As part of the Barcelona Science programme, the Citizen Science Office has been created to consolidate existing citizen science projects, support them in the socio-environmental challenges facing the city and create a shared learning space for new initiatives. Some of the projects carried out were BioBlitzBcn, Beepath and Mosquito Alert.

11.3.5 The network in action

Citizen Sustainability Council

Members of the Citizen Sustainability Council represent the More Sustainable Barcelona network and contribute to spreading the sustainability culture throughout the city by promoting the Citizen Commitment to Sustainability, its implementation and monitoring it. This includes a very active standing committee and various working groups.

This council replaces the Municipal Environment and Sustainability Council set up in 1998 to promote Agenda 21 in Barcelona.

2018 More Sustainable Barcelona Convention

Since the creation of the Citizen Commitment to Sustainability and the More Sustainable Barcelona network, four conventions have been held, all designed to assess the achievements and propose challenges for the future in a participatory manner.

Having reached the halfway point of the Citizen Commitment to Sustainability, on 25 January 2018, around 300 people from more than 150 organisations in the More Sustainable Barcelona network came together to analyse its first five years and reflect on future challenges. In order to assess the achievement of each of the Commitment's objectives, a summary of the main strategic plans, programmes and projects was drawn up for each objective and line of action.

In the course of the day, six challenges were prioritised for 2022 and more than 1,000 specific action proposals were put forward for achieving them. The challenges are as follows:

- → Increase and improve the green areas of the city with citizen co-responsibility.
- → Bring about a shift in the means of transport for more sustainable mobility and improve air quality.
- → Protect the climate. Reduce energy consumption and GHG emissions. Prevent and manage the consequences of climate change.
- → Position sustainability as an important subject in everyday life.
- → Roll out the "Zero Waste" strategy.
- → Work towards a more responsible production and consumption model.

Let's move into action! Networking groups

As a result of the More Sustainable Barcelona convention, in 2018, three new working groups were created to address challenges discussed at the convention: greenery and biodiversity, energy and climate change and zero waste. The aim of these working groups is to guide the actions of the More Sustainable Barcelona network by promoting and driving its activities and projects, and to have an impact on public policies.

Axes of the three working groups created in the More Sustainable Barcelona Convention in 2018.

	Challenge	Lines of action	Members
Greenery and biodiversity	Increase and improve the green areas of the city with citizen co-responsibility	• Re-greening the city • Citizen involvement • Change in the green culture	45 people from 38 organisations receive information
Energy and climate change	Protect the climate. Reduce energy consumption and GHG emissions. Prevent and manage the consequences of climate change.	• Community energy management and shared self-consumption • Climate refuges	Climate Change commission: 16 Energy commission: 15
"Zero Waste"	Roll out the "zero waste" strategy	• Waste prevention • Drinking without plastic	55 people from 46 organisations receive information

At the request of its members, in 2018 the working group for the More Sustainable Barcelona Map was included in the Citizen Sustainability Council. Thus, these three new groups also form part of the Council.

Training, exchange and shared initiative promotion activities

The More Sustainable Barcelona Secretary's Office offers advice and resources to all network organisations and promotes different types of training, information and experience exchange activities.

In addition to day-to-day support work, some periodic events are organised, for example, the More Sustainable Barcelona Lunches ⊕, which are participatory sessions at which three organisations in the network explain an initiative on a specific theme, such as the transition to energy sovereignty or resilience in the city. Another example is Fem Xarxing! ⊕, an annual networking event held since 2014 where organisations share experiences, create synergies and start shared projects.

The Climate Plan, a plan co-produced with residents

The fight against climate change requires the maximum involvement of city residents. That is why the Climate Plan ⊕ has been coproduced with residents and members of the More Sustainable Barcelona network be means of a participatory process. Various face-to-face sessions were organised and the Decidim platform was launched, with around 100 actors participating and 112 proposals submitted, of which 85% have been included in the plan's lines of action.

At the same time, nine citizen initiative projects ⊕ were defined and rolled out, and implemented over a two-year period, with some very significant results in some cases (green roof competition, pilot door-to-door refuse collection in Sarrià, etc). As a result of the lessons learned in this process and to continue stimulating citizen action, a call for citizen climate project subsidies ⊕ has been organised *(see Section 1.3.4, "Extending the energy culture to involve citizens in the change")*.

11.4 Future goals and measures

To continue the work started and become a more sustainable city by means of a project shared with city organisations and residents, we must consolidate the current good lines of work and spare no effort in speeding up further advances.

Strategic sustainability culture plan

With a view to consolidating the existing strong lines of action and speed up progress, a strategic sustainability culture plan is due to be drawn up to facilitate systematisation and prioritising action.

Renewing the Commitment and strengthening the network

In the coming years, it will be necessary to renew the Citizen Commitment to Sustainability (2012-2022) and give a more prominent role More Sustainable Barcelona network members, as well as support resources, especially at schools and shops. The twentieth anniversary of the More Sustainable Schools programme will provide an opportunity for revising and relaunching the programme.

Consolidation of the network of environmental facilities

La Fàbrica del Sol needs to be consolidated as a reference centre and a catalyst for the sustainability culture in the city and the network of environmental classrooms in all the city's districts needs to be completed.

In that regard, the recovery of Port Olímpic for public use will provide an opportunity to expand the modest Beach Centre and create a centre for Mediterranean knowledge and conservation *(see Section 5.4.2, "Planning instruments for recovering local use of the coast")*.

Partnerships to reach all residents

Reaching all residents entails more work by the Urban Ecology Manager's Office but, above all, building partnerships in the area of culture and education and working with all local cultural facilities.

Technical management and coordination
Teresa Franquesa, Toni Pujol and Irma Ventayol
Strategy and Sustainability Culture Department. Urban Ecology
Barcelona City Council

Municipal staff involved in the 2018 Environment Report:
Jaume Barnada, Helena Barracó, Mar Campanero, Roser Carvajal, Joan Marc Craviotto, Marta Cuixart, Margarita Fernández-Armesto, Ares Gabàs, Rosa López, Adriana Malé, Ariadna Miquel, Jana Miró, Margarita Parés, Jordi Remírez, Laura Reñaga, Marc Rico, Coloma Rull, Irma Soldevilla, Xavier Varela, Cristina Vila, Marta Vilar, Laura Zapata i Lorena Zurrón.

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